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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Television

The B.B.C.'s Responsibility

IN October last year a rumour got about that the B.B.C. intended to discontinue the 30-line television transmissions when their agreement with the Baird Company expired in the spring. In the following month we said that these rumours, which were still circulating, should not be taken too seriously, because the short-wave transmissions which it was suggested would replace the 30-line television could not be expected to give a service at present, but would at first be only experimental. We went on to say that if a television *service* was to be maintained, it would be by continuing transmissions along existing lines for the present.

The intention of the B.B.C. to curtail the present 30-line transmissions to two instead of more a week has recently been disclosed, their excuse for doing so being based on the assumption that there is insufficient public interest in these broadcasts.

The B.B.C. does not seem to appreciate that so long as they have a monopoly of broadcasting they have also a responsibility to the public in the matter of television. When their more frequent transmissions began public interest was very small, but it has undoubtedly grown, and to-day there are a far larger number of enthusiasts than at any previous time, so that it seems to be a most inopportune moment to suggest a curtailment of the service when no better system has yet been made available to the public. We still regard the high definition transmissions as only experimental, and even if the transmission problems have been overcome, reception difficulties outside the laboratory have not been tackled to a point where the public can join in and take advantage of them.

In this issue we publish an article written by a prominent engineer who has had much experience with the development of television. He states the case for a continuance of 30-line transmissions, and suggests that these transmissions should be used to better advantage. He criticises the present arrangement whereby pictures far too ambitious for the system are frequently broadcast. The 30-line system can be definitely good if the subject televised is sufficiently large, but to try to put over pictures of detail merely serves to discredit the system and emphasise its limitations. In a recent issue a contributor to our Broadcast Brevities column deliberately implied dissatisfaction with 30-line transmissions in order to stimulate protests from those who are really interested in these tests. A large number of post-cards and letters has been received at our offices as a result, and in this issue we have thought it of interest to publish extracts from representative communications.

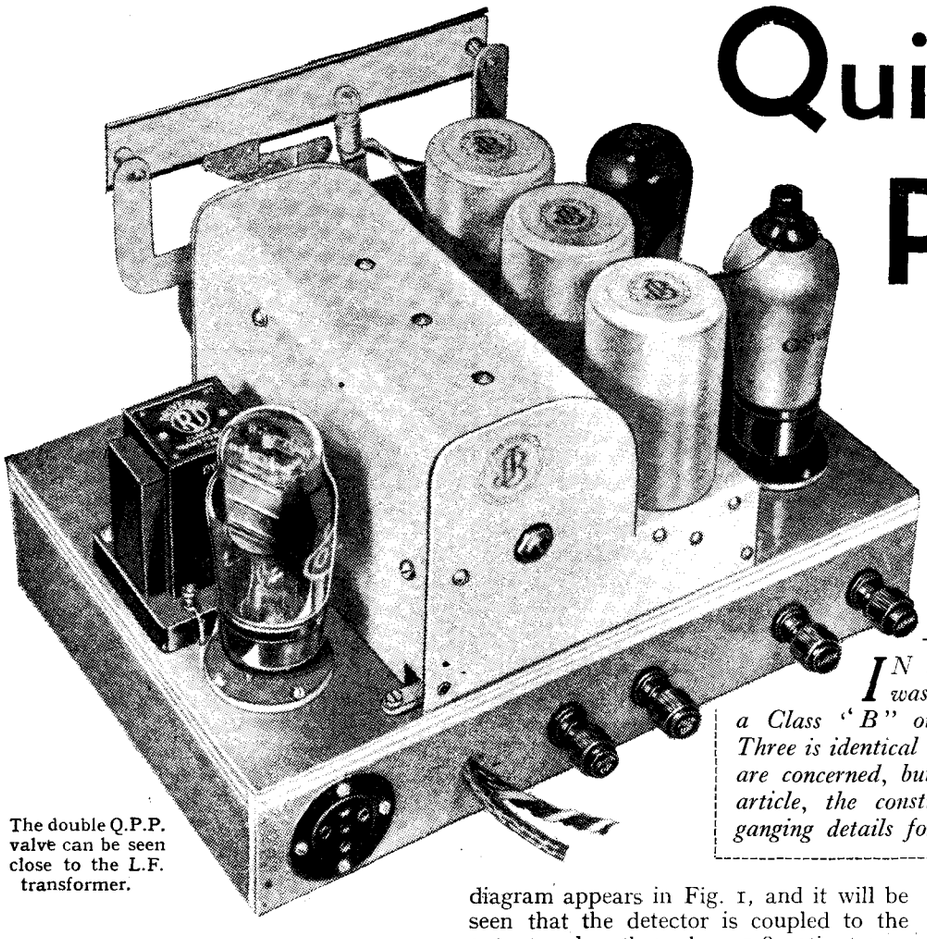
30-line Broadcasts Must Go On

We would urge the B.B.C. to give the 30-line transmission more attention, with at least some transmissions during more convenient listening periods.

High definition transmissions are on their way, but since these necessitate ultra short-wave reception, with a very restricted range for the transmitters, we cannot expect any speedy progress on the reception side, and until the short-wave transmissions can be regarded as giving an equivalent *service* to what is now possible on the medium broadcast band there should be certainly no curtailment of the present facilities.

Quiescent Push-Pull Three

A Battery Receiver Embodying an H.F. Pentode



The double Q.P.P. valve can be seen close to the L.F. transformer.

IN last week's issue the H.F. Pentode Four was described, and this set was fitted with a Class "B" output stage. The Quiescent Push-Pull Three is identical as far as the H.F. and detector stages are concerned, but has a Q.P.P. output stage. In this article, the construction of this set is described and ganging details for both receivers are given.

AT the conclusion of the article describing the H.F. Pentode Four in last week's issue, it was stated that the receiver would be re-described with an alternative output stage. The H.F. and detector circuits of the present set are identical with those of the H.F. Pentode Four, and the only changes occur after the detector. The complete circuit diagram appears in Fig. 1, and it will be seen that the detector is coupled to the output valve through a 1-8 ratio transformer. This component, unlike the driver transformer of a Class "B" system, is of the ordinary push-pull type.

Previously, the quiescent push-pull system has necessitated the use of two output pentodes, and has been rather unpopular on account of the high initial cost of the apparatus. This drawback has now been removed by the appearance of the QP.21, which is a double valve consisting essentially of two pentodes built into a single bulb, and selling at a lower price than the two equivalent separate pentodes. From the point of view of the user, the most important point about it is that it requires no driver valve, and it can be fed directly from the detector, provided that the coupling transformer is of high enough ratio. As compared with a Class "B" system, therefore, fewer components are needed.

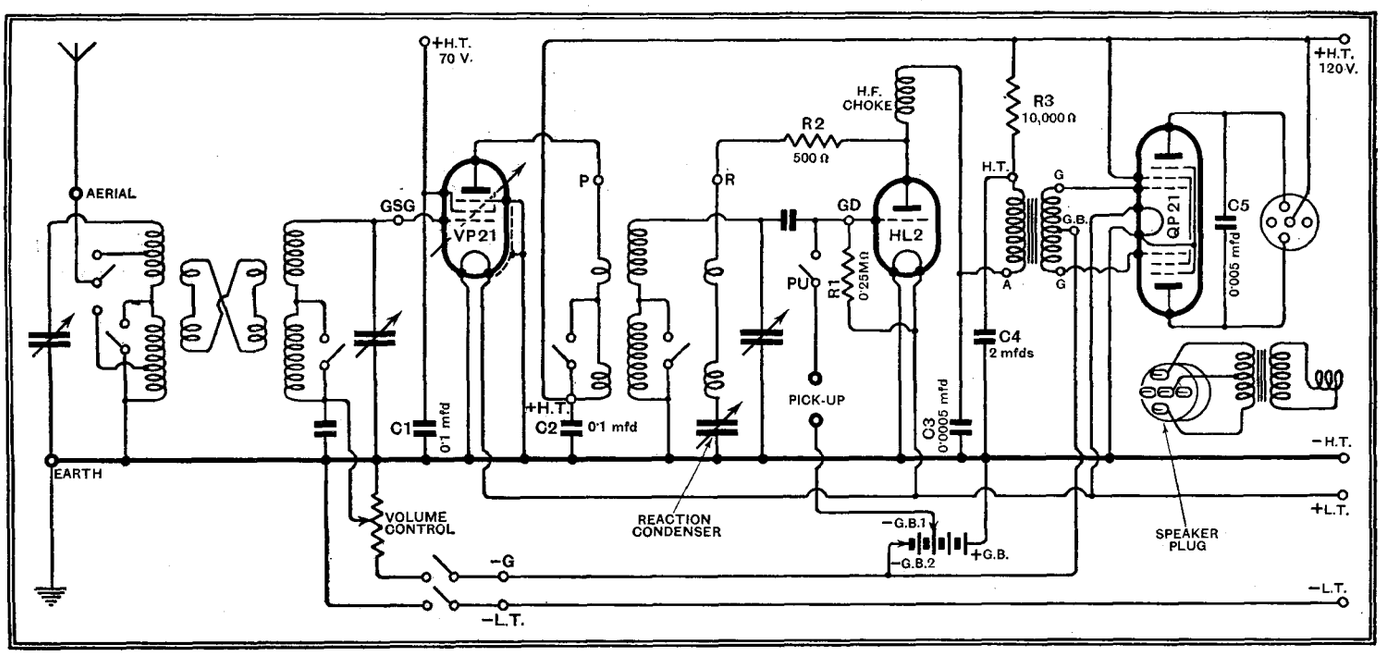


Fig. 1.—The circuit diagram of the receiver embodying the Q.P.P. output stage.

Quiescent Push-Pull Three—

The maximum undistorted output of the QP.21 is less than that of the B.21 when both are operated at the same anode potential. Thus, at 120 volts, the QP.21 will give an output of about 570 milliwatts, as compared with the 900 milliwatts of the Class "B" system. At 150 volts some 970 milliwatts are obtainable from the Q.P.P. valve, and 1,500/2,000 milliwatts from the B.21. The choice between the two systems, therefore, will be dictated very largely by the output required.

One point should be noted specially, however. If an output of some 900 milliwatts be needed, it may be obtained in two different ways. The Q.P.21 may be used with a 150 volts H.T. supply, or the B.21 with 120 volts. The Q.P.P. system thus requires a higher voltage battery, but it imposes a lighter current drain upon it, so that there will probably be very little to choose in the matter of running costs, and a choice should be made upon other considerations. In general, the Q.P.P. system will give slightly better quality of reproduction than Class "B" for an output less than the maximum. At the maximum output, of course, there is no difference, for the output figures are quoted for the same harmonic content in each case. The point is, however, that, as the output is reduced, harmonics fall off more rapidly with the Q.P.P. system.

The higher anode voltage will also lead to an improved performance in the H.F. stage, although it will naturally also cause an increase in the current consumed by this valve. The choice, therefore, will be dictated by a large number of different factors which must be balanced by the individual, for they will obviously vary considerably in different circumstances. The sensitivity and selectivity remain largely unaffected whichever output stage be used, the balance on sensitivity being slightly in favour of Class "B," since the driver valve does give some amplification.

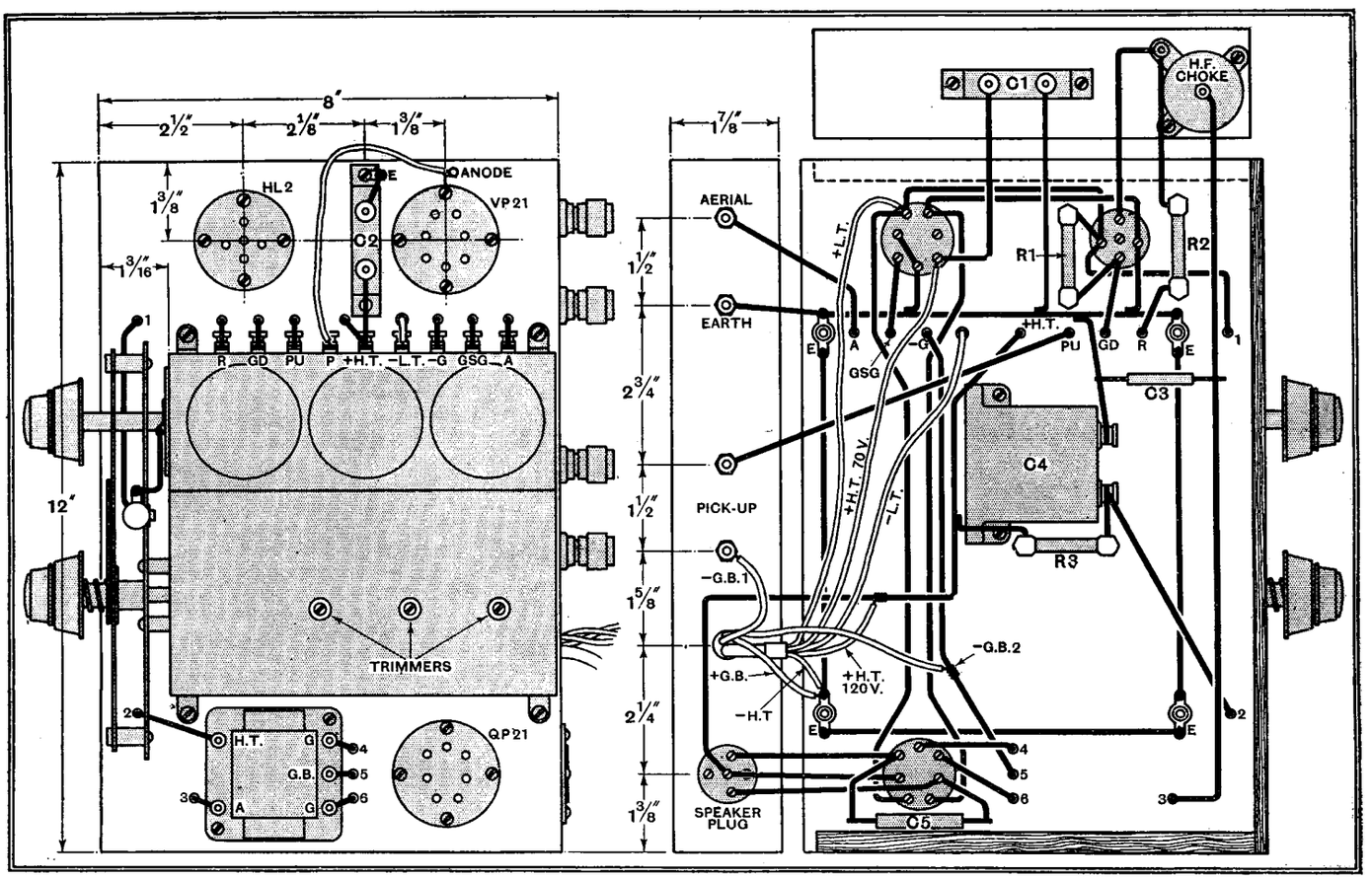
On test, the receiver proved to have substantially the same performance whichever output stage were used, and in consequence the notes on performance given in the previous article may be taken as applying also to the set with the Q.P.P. output stage. The total anode current consumption with no signal is about 8.8 mA. with a 120 volts H.T. supply, and the filament current is 0.66 ampere, including the dial light. The filament current is higher than with the four-valve arrangement, since the QP.21 valve requires 0.4 ampere, whereas the B.21 needs only 0.2 ampere, and the L.21 0.1 ampere.

Whichever output stage be adopted, the initial adjustments are the same, and are only to the ganging. They are simple and readily carried out. A station on the medium waveband should be tuned in and the volume adjusted to a convenient level by means of the volume control. Each trimmer should then be adjusted for maximum response, simultaneously turning down the volume control if the response becomes too great.

The circuits are now roughly ganged, and no difficulty should be experienced in tuning in a station on a low wavelength, preferably below 250 metres. A weak station should be selected, so that it is necessary to use a certain amount of reaction for adequate volume. Each trimmer should then be carefully adjusted for the loudest signals, slacking off the volume control knob if the set goes into oscillation as the circuits come into tune with one another. If a definite optimum setting can thus be found for each trimmer, such that any further increase or decrease in its capacity reduces signal strength, the ganging is completed, and there is nothing further to do.

Should it be found, however, that one trimmer is fully unscrewed, it is a sign that ganging is being attempted with too little capacity in the trimmers. All trimmers, therefore, should be screwed up somewhat, the station retuned at a slightly lower dial setting, and the ganging process recommenced. On the other hand, if one trimmer is fully screwed home, it is a sign that too

PRACTICAL WIRING DIAGRAM



The assembly and wiring of the set are clearly shown in these drawings.

A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E 1. Price 1s. 6d. post free.

Quiescent Push-Pull Three—

much trimmer capacity is being used on another circuit. All trimmers should be unscrewed a little and the station retuned at a slightly higher dial reading, after which correct ganging should be obtainable.

Once these adjustments have been properly carried out, the ganging should hold accurately over the whole of both wavebands, and no further adjustments should be necessary. Quite a moderate amount of reaction is needed for the reception of many foreign stations, and with some of the stronger the volume will probably have to be reduced. The range of control obtainable depends upon the bias employed for the output valve, since the terminal for this connection on the "pack" is commoned with the bias supply to the output stage.

Bias Voltages

With the Class "B" output stage, therefore, the bias range available will be from zero to 4.5 or 6 volts according to the H.T. supply used. With the QP.21 valve a somewhat higher bias will be available, since the output valve requires from 7.5 to 9 volts according to the anode voltage. Under normal conditions the voltage required for the operation of the volume control is not critical, and 4½ volts is usually sufficient. In a few cases, however, where the set is used close to a local station, a somewhat increased range may be advisable to permit that station to be reduced sufficiently. This may easily be obtained by wiring the "−G" terminal of the "pack" to the −9 volts terminal of the bias battery instead of connecting it *via* the internal wiring to the same point as the output valve.

In conclusion, it may be remarked that these two receivers are economical to operate from batteries, and that they can be used for the reproduction of gramophone records by the connection of the usual pick-up and volume control potentiometer to the terminals provided. They are essentially sets for battery operation, however, and it is not recommended that any attempt be made to obtain the H.T. supply from the mains. Class "B" and Q.P.P. output systems are intended for battery operation, and do not lend themselves nicely to mains working. Where mains are available, a mains receiver should be used, not a battery set with an H.T. eliminator.

It may be remarked that the QP.21 valve is a new type, and has only just been released by the makers. It is not anticipated that there will be any difficulty about obtaining the valve, but it should be remembered that supplies may be somewhat restricted for a short period.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

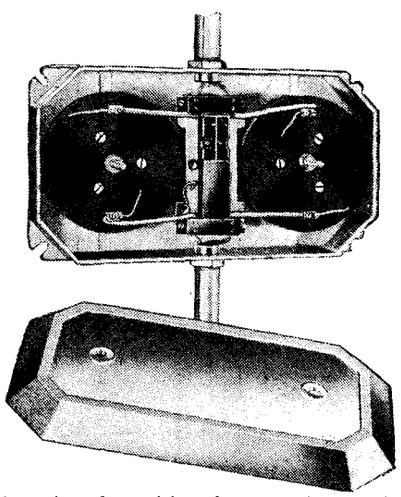
1 Linacore Bandpass Tuner — **J.B. Type BPB**
1 Bulb, 2 volts, 0.06 amp. — **Bulgin Type H**
1 H.F. Choke — **Kinva**
(Bulgin, Wearite.)
2 Fixed Condensers, 0.1 mfd., 200 v. D.C. working, **C1 C2** — **T.C.C.50**
1 Fixed Condenser, 2 mfds., ditto, **C4** — **T.C.C.50**
1 Fixed Condenser, 0.005 mfd., **C5** — **T.C.C. Type M**
1 Fixed Condenser, 0.0005 mfd., **C3** — **T.C.C. Type M**
(Dubilier, Peak, T.M.C. Hydra, Telsen.)
1 Metallised Resistance, 500 ohms, 1 watt, **R2** — **Dubilier**
1 Metallised Resistance, 10,000 ohms, 1 watt, **R3** — **Dubilier**
1 Metallised Resistance, 250,000 ohms, 1 watt, **R1** — **Dubilier**
(Claude Lyons, Erie, Graham Farish, Seradex, Watmel.)
1 Q.P.P. Transformer, 1 : 8 — **R.I.**
(Multitone, Varley.)
2 5-pin Valve Holders — **Clix Chassis Mounting Standard Type**
2 7-pin Valve Holders — **Clix Chassis Mounting Type**
1 G.B. Battery, 9 volts
1 5-way Battery Cable, 30in., with wander plugs and spade ends — **Belling-Lee**
3 Wander Plugs — **Clix Type B**
4 Ebonite Shrouded Terminals, A., E., Pick-up (2) — **Belling-Lee Type B**
Plymax Baseboard, 8 in. x 12 in. x ⅜in. — **Peto-Scott**
2 oz. No. 20 tinned copper wire, 3 lengths Systoflex, wood, flex, etc.
Screws:—
24 ⅜in. No. 4 R/hd., 6 ½in. No. 4 R/hd., 4 ¾in. No. 4 B.A. with metal thread and nuts and washers.
Valves: 1 Osram or Marconi VP21; 1 Osram or Marconi HL2; 1 Osram or Marconi QP21.
1 Microfode Loud Speaker — **W.B. Type PM4A**

A Quieter Background

WIRELESS users are at last waking up to the fact that there is no longer any real reason to accept passively a background of crackling, buzzing, or frying noises as an accompaniment to the programmes.

True, atmospherics will always be with us, and no one has yet found a satisfactory way of disposing of them. But in these favoured latitudes we may expect virtual immunity from serious atmospheric interference for at least 90 per cent. of our listening time—at any rate, so far as short- or medium-distance reception is concerned.

Again, it is admitted that certain forms of man-made electrical interference are susceptible only to suppression at the source, and so the listener can do little or nothing to improve matters. Fortunately, it is to be anticipated that such forms of interference will tend to decrease.

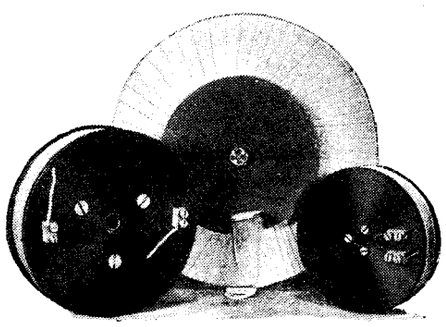


A pair of anti-interference chokes, in screening case, wired in the mains leads.

There is undeniable proof that the average listener can himself do a great deal to clear away background noises, and there is no risk in saying that, at a conservative estimate, fifty per cent. of sufferers have it in their power to improve matters to a more than acceptable extent. A few years ago little was known of the nature of electrical disturbances or of how to cure them, but now, largely as a result of intensive research on the part of the Post Office engineers, much valuable information on the subject has been made public. Further, anti-interference devices have become available from a number of sources.

The firm of Belling and Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex, have for some time concerned themselves both technically and commercially with the problems of interference suppression, and it is the purpose of this note to draw attention to a 16-page booklet entitled "Disturbance Suppression," which they have just issued. Readers may obtain copies at 3d. each, post free.

The various uses of the simple condenser



Specimen Belling-Lee heavy-duty H.F. chokes; the largest is wound with copper tape.

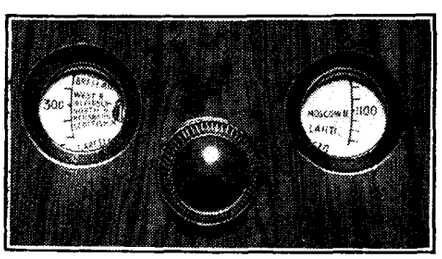
suppressor are described at length in the clearest possible language, and with a number of diagrams and wiring plans. Information is also given on the use of the new Belling-Lee chokes in cases where an unaided condenser filter is insufficient.

Negligible Voltage Loss

These chokes have current ratings of between 3 amps. and 100 amps., and are made in accordance with Post Office recommendations, the higher ratings being wound with copper tape. The 50-amp. choke, for example, has a resistance of only 0.0127 ohm, and, run at its maximum rating, would absorb only 0.635 volt, which is entirely negligible. For ordinary domestic use it is seldom that a choke with a higher rating than 25 amps. would be necessary, even assuming it to be so wired that the whole of the domestic supply would pass through it.

The uses of other Belling-Lee anti-interference devices are also described. The booklet is one that can be thoroughly recommended, even to those who think that they stand but a slender chance of reducing background noises.

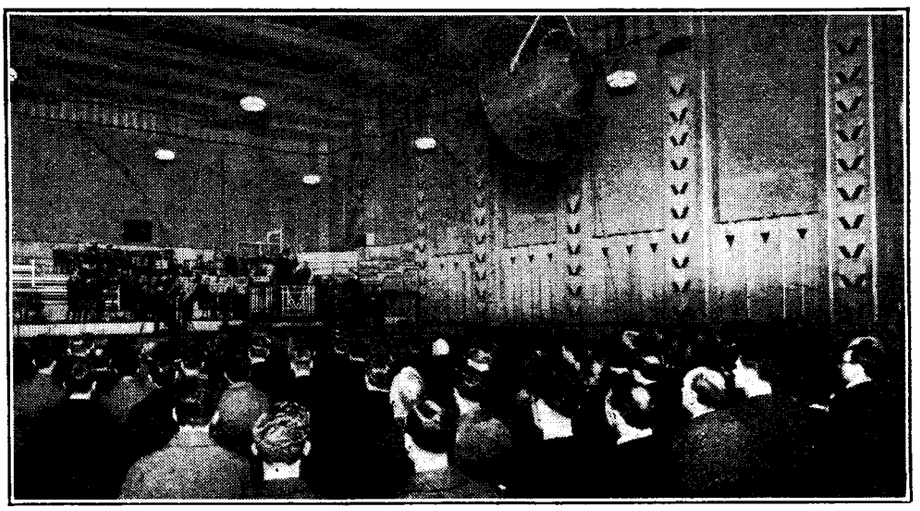
EASIER TO READ



Improving the tuning dial: the viewing apertures of the latest Ferranti sets are fitted with magnifying lenses.

Behind the Scenes at the H.M.V. Recording Studios

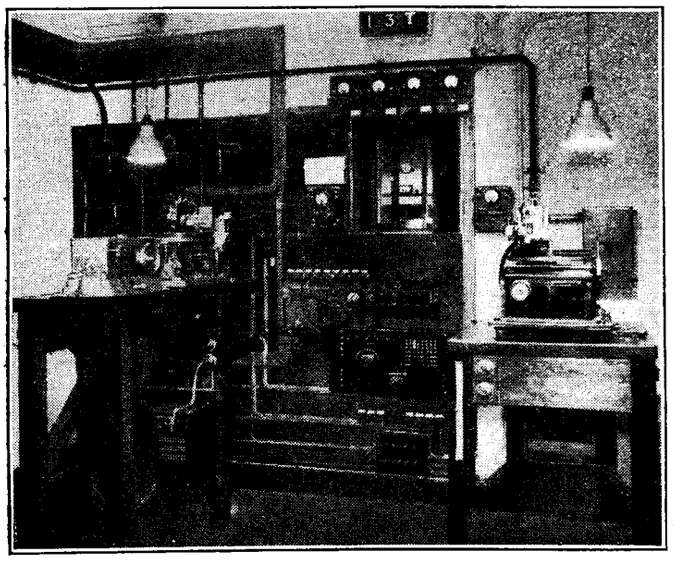
How Modern Electrical Recordings are Made



General view of the No. 1 studio for recording choral and orchestral works

IN November, 1931, the whole of the recording organisation of the Gramophone Company was transferred from Hayes, Middlesex, to St. John's Wood, London, N.W. The move was made primarily in the interests of the recording artistes, who can now fit in a recording session more conveniently with their London concert engagements; but the technical staff were quick to seize the opportunities presented to them, and the new building is probably unique inasmuch as it is designed throughout for the exclusive purpose of gramophone recording.

All the studios have been acoustically designed for the special requirements of recording, and the temperature of the building as a whole is kept at a level suitable for the wax discs. The warning lights outside studios create an atmosphere reminiscent of Broadcasting House, and this impression is strengthened when it is discovered that a special department is devoted to the cataloguing and storing of music.



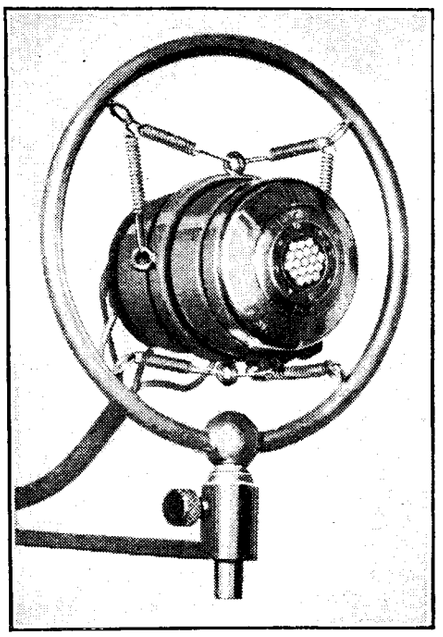
Interior of one of the machine rooms, showing twin recorders and double window communicating with the studio.

There are four studios ranging from the No. 1 orchestral studio, capable of accommodating two hundred performers on the stage and seven hundred on the floor, to the small talks studio. The acoustic properties of the large studio can be modified for different types of performance by movable screening partitions and damping curtains. It is possible to use as many as four microphones simultaneously, and there is a parabolic reflector which may be used to obtain the required balance in special circumstances.

The microphones are of the moving-coil type, and have been designed and developed by the Gramophone Company. They are energised from accumulators, and the field strength is adjusted to a predetermined value as it exercises some control over the frequency characteristic. It is interesting to note that the miniature diaphragm attached to the moving coil is of balsa wood.

Each studio has its own recording room, and the recording engineer is able to communicate with the studio staff through a small double window. In the general view of one of the recording rooms will be seen the four small control panels and meters immediately above the window which supply the field current to the microphones. The two similar panels at the lower corners are for the moving - coil recorders. Immediately below the window are the mixing and fading controls for the microphones, a system of tone correction filters, and the main volume control which is calibrated in decibels.

The recorder turntables are driven by gravity weights, and governors of special design are employed to keep the speed constant. The recorder head is fixed, and the turntable is gradually moved sideways by the lead screw. The recorder head works on the moving-coil principle, and the speech coils are fixed on the pole pieces of a powerful electro-magnet. The drive is transmitted to the cutting stylus by a single-turn coil which is closely coupled magnetically to the speech coils. The unit as a whole is carefully counterbalanced, and a micrometer feed is provided to vary the depth of the cut. An air suction tube immediately behind the stylus removes all traces of wax shavings from the surface of the record. Although



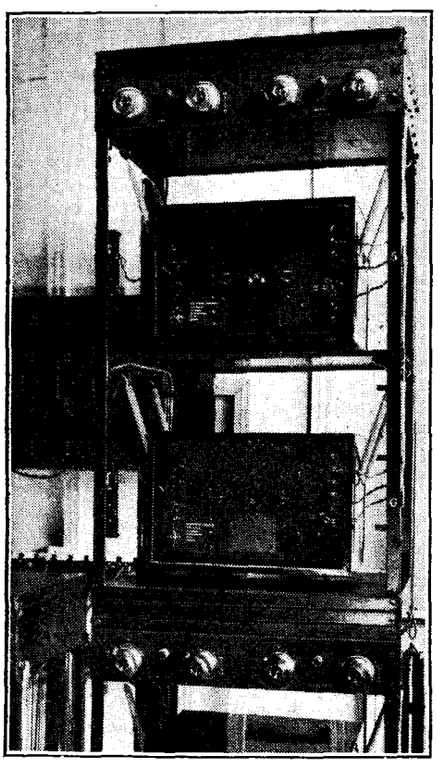
The moving-coil microphone.

Behind the Scenes at the H.M.V. Studios—

it is not often necessary, an immediate play-back may be taken from the wax by a specially designed pick-up mounted on the opposite side of the swivel head.

Wax blanks are stored in a thermostatically-controlled heating cupboard in the machine room itself. As the room temperature is very little below that of the store cupboard, the heat radiated from the electric lamp immediately over the turntable is sufficient to maintain the wax at the correct consistency during the comparatively brief period taken to complete the recording.

The microphones and recording amplifiers for all the studios are assembled together in a room on the first floor, and by an elaborate system of screened permanent wiring any desired combination of microphones, amplifiers and recorders can be arranged. Thus, in the case of an important broadcast several master waxes can be cut simultaneously. H.T. current

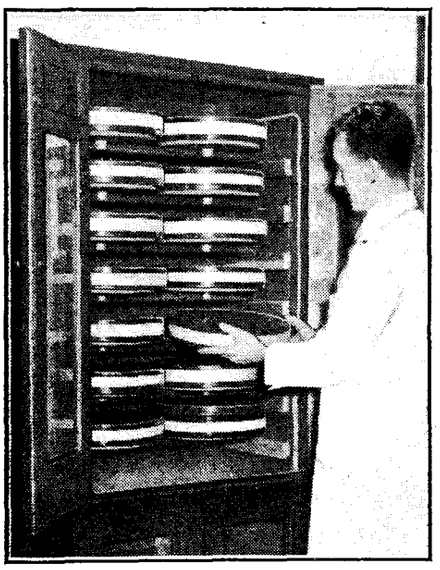


Spring-suspended microphone amplifiers.

for the amplifiers is obtained ready smoothed from the adjacent rectifier room in which there are five separate channels employing mercury vapour rectifier valves. There is also a battery room from which filament heating current is obtained. As in the case of the microphones and recording machines, the whole of the amplifying equipment has been developed and built by the H.M.V. Research Department.

The sapphire cutting points are all prepared, on the premises, from the rough stone, and the equipment includes a powerful projection microscope by means of which the cutting angles can be accurately measured.

The editing of records such as the Aldershot Tattoo is carried out in the Transfer Room, where excerpts from a series of master records can be combined to give a playing time of the required



The recording waxes are stored in a temperature-controlled cupboard.

length. The Acoustics Section is provided with a research laboratory, and a special room is set aside for recording from Broadcasting House, to which a permanent private line is connected.

The air-conditioning plant occupies most of the basement, and is important not only in keeping the building at the temperature required by the waxes, but also to eliminate variations in the humidity of the sound-absorbing material in the walls of the studios.

In conclusion, the skill of those responsible for the disposition of microphones and studio technique in general should not be overlooked. The modern record is the result of a happy combination of art and science.

Twenty Years Ago

Extracts from *The Wireless World* of March, 1914

Notes of the Month:—

"A mild sensation was caused during the past month by the report that 'a well-known French engineer' (of whom, by the way, we do not appear to have heard before) had 'discovered' that 'dangerous explosions are liable to occur at the meeting points of wireless electric waves.' This startling theory was backed by the reminder that 'the *Volturno* disaster took place just at the junction point of the Eiffel Tower and Glace Bay Wireless lines (!) and the recent mining explosion near Cardiff on the Clifden-Paris line (!), while Toulon, where the explosions on board the battleships *Jena* and *Liberté* occurred, is on the Paris-Bizerta line,' Some of our friends in the Press appear to have taken this report seriously. . . . We hope that timid persons will accept our assurance that nothing of the kind predicted can happen. Anybody at all acquainted with wireless knows that the waves do not leave the station like a bolt! They spread out like a vast fan."

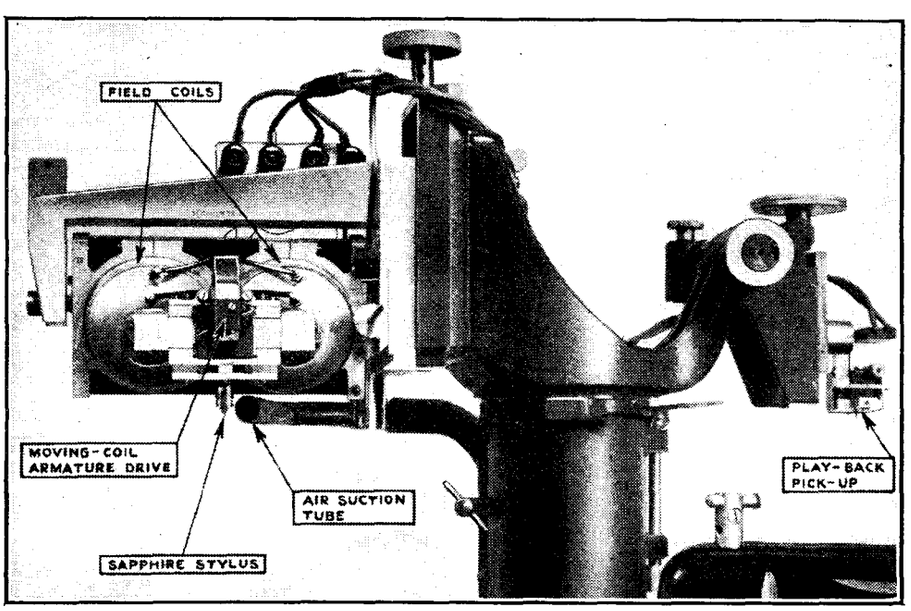
Amateur Notes:—

"We were only able to refer briefly in our last issue to the inaugural meeting of the Wireless Society of London (now the Incorporated Radio Society of Great Britain—ED.) on January 21st, which, from every point of view, was an unqualified success. Never have we seen the large lecture theatre of the Institution so crowded.

"An aerial was erected on the roof, and arrangements were made to receive a message from the Eiffel Tower. This was received on a syphon recorder, and the movements of the pen marking the strip were clearly shown on the screen by the use of a Lietz Universal Projector."

Questions and Answers:—

"A.C. (New Brighton) has a one-slide tuning-coil, which he puts in series with a two-tappings coil; he puts the aerial on to one end of this combination, and then leads the other end to earth through his silicon-platinum detector, across which he shunts a pair of phones, 100 ohms each, and connected in parallel. He is altogether wrong; he has got a high-resistance crystal in series with his oscillating aerial circuit; not only that, but the crystal is situated at the point of lowest potential instead of highest; and he is using telephones which are not in the least suited to 'wireless' unless used in conjunction with a telephone transformer."



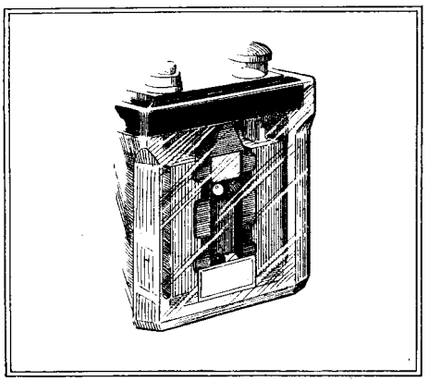
A close-up of the moving-coil recorder showing play-back pick-up.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

Charge Indicators

FOR several years past a number of accumulator manufacturers have adopted the practice of fitting built-in "charge indicators," usually in the form of hydrometer beads which are immersed in the acid, but are visible through the container. The beads are coloured distinctively, and their respective specific gravities are so adjusted that as the density of the acid electrolyte decreases during discharge the beads, one after the other, fall to the bottom of the compartment in which they are retained.



Visual charge indicator, as fitted to an L.T. accumulator cell (Exide).

It is easy to see that in this form of charge indicator we have most of the advantages of a hydrometer without the messiness usually associated with the use of the instrument. But if full benefit is to be derived from the system the user should bear in mind a few special points. For instance, during the changing of the accumulator, gas is evolved and bubbles will often lodge on the beads. In consequence, the specific gravity of the bead as a whole may be greatly reduced, and so a false indication may be obtained. It it as well to shake the cell vigorously, or else to tap it on the table, in order to dislodge any small bubbles, and thus to make sure that the beads are really floating without help.

Again, it is possible by observing the behaviour of the beads to form a good idea of intermediate states of charge. Let us assume that the read bead sinks when the cell is fully discharged; if this bead is noticed to sink slowly when shaking the cell, and then to rise very sluggishly towards the surface, one knows that the need for recharging is imminent.

Obviously, these charge indicators depend for their effectiveness on the initial gravity of the electrolyte being correctly adjusted, and so it is important that the manufacturers' recommendations be followed implicitly. It is also wise to maintain the electrolyte at a constant level, and of course any acid that may be spilled must be made good.

The Aerial Trimmer

IT is fairly safe to say that no method has yet been devised whereby a ready-made receiver shall be entirely independent of the variations in capacity between one aerial and another. In the design of a few sets, special precautions are taken to minimise the effect of these variations, but more often than not the matter is left to chance.

A difference in capacity of only 25 micro-mfds. between the standard artificial aerial on which the receiver is ganged at the factory and the actual aerial with which it is used will appear on the average as a difference of 5 micro-mfds. across the input circuit. Even this small variation is enough to impair efficiency; the moral is that there is a very good chance of improving the performance by adjusting the trimmer associated with the aerial circuit when the set is installed.

Although those who have no experience of the somewhat delicate operation of trimming should be strongly discouraged from making wholesale alterations to initial adjustments, it may be pointed out that the alteration *of a single trimmer* requires no special skill, and is usually carried out in a few moments.

The reader may be reminded that a visual tuning indicator, as fitted to many modern sets, is a very useful aid to making adjustments of this nature. The procedure is first to tune in a low-wavelength station very carefully, so that maximum response is indicated, and then to make the trimming adjustment.

A Two-way Device

IT is not always realised that a condenser anti-interference filter, fitted at the point where the mains enter the building, is likely to prevent the egress as well as the ingress of interference. Nevertheless, there is little doubt that it generally does function in this way, and it will be reassuring to the conscientious user of electrical appliances to know it. If the filter is working according to plan, interference from such domestic appliances as vacuum cleaners, sewing machine motors, etc., although it may be transferred to the electrical wiring of the house, will not be allowed to get any further, and so will not upset the reception of neighbouring listeners.

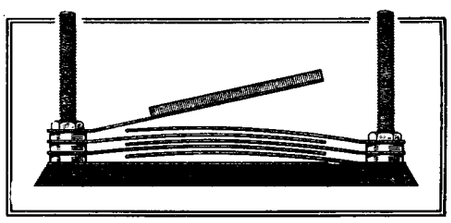
It may be urged that, in his own interests, the listener should fit suppressors directly on all apparatus that is found to cause interference, but in the case of appliances that are never used while his own wireless set is in operation, individual treatment is probably quite unnecessary, and may be neglected with a clear conscience, provided a mains filter be fitted.

Testing Compression Condensers

AN important application of the semi-variable compression condenser nowadays is for "padding" purposes in the oscillator circuit of superheterodyne receivers. Comparatively large capacities (up to 0.002 mfd.) are generally specified for this purpose; it would appear that defects in such condensers are not altogether unknown, and that they are perhaps rather more likely to arise than in smaller condensers of the same type.

After a certain amount of use, it may be found impossible to obtain a wide range of capacity adjustment; here we have an indication either that the plates are made of unsuitable metal and have lost their springiness, or just possibly that the top plate has become displaced and is bearing against the side of the container. The accompanying sketch, which shows the construction of a typical padding condenser, will make it clear how such troubles can arise.

It is often possible to form a shrewd opinion as to whether the condenser is working properly by removing the adjusting screw and then inserting a piece of stiff wire, or even a small nail, through the tapped hole. As the nail or wire is



Construction of a padding condenser; mica interleaving sheets omitted.

pressed downwards it should be possible to feel a gradual increase in resistance; as pressure is released the wire should again be forced upwards by the natural springiness of the plates.

If, after constant use, the plates have become slightly flattened, the minimum capacity of the condenser will be unduly high. It is not difficult to reduce it to the original value by judicious rebending, but care must be taken in handling the mica interleaving sheets, and also in replacing them.

Broadcast Television

The Case for Continuing 30-Line Transmissions

THE author of this article, who is an engineer of repute with considerable experience in the field of television, puts forward some interesting views on the question of television development. Some of the opinions expressed are definitely controversial and may lead to discussion on this extremely topical subject.

HIGH-DEFINITION transmission which is known to have reached an advanced stage of technical development is on the point of being given a public trial by the B.B.C. Behind this effort are the hopes and best wishes for its success of all those who have the true interests of television at heart.

Low-definition television has already been given a trial on a medium wavelength by the B.B.C. on the Baird system extending over a considerable period, but the demand for television receivers has not been large, and the conclusion has been reached that the public shows little interest in the continuance of the service. It has even been suggested that low-definition television has had its day and should now be dropped. The writer, however, believes that there is an active future for both high- and low-definition systems, and if certain misunderstandings of the technical position are removed, and it can be shown that the limited public support accorded to the B.B.C. 30-line transmissions implies no reflection on low definition as such, then the situation would be altered, as a case is thus made out for mission on more favourable lines that are likely to meet with a better response from the public.

Such is the purpose of this article, which concludes with a statement of the conditions which it is recommended should apply to any further service of this nature.

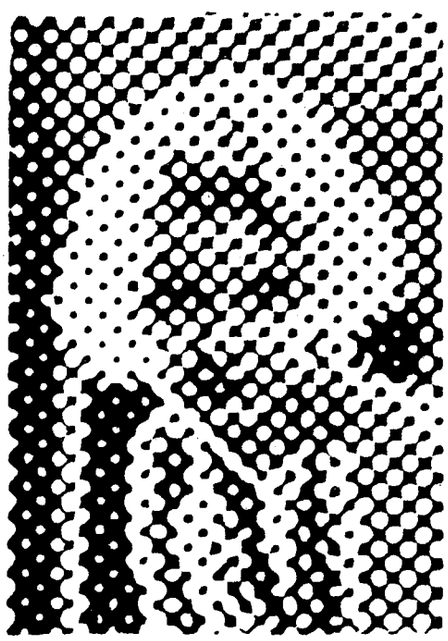
First, let us clear up some of these misunderstandings. For instance, the terms "low definition" and "high definition" are misleading. Low-definition television can show better definition of a single head than high-definition television if there are many figures in the high-definition picture. "Narrow frequency band" or "narrow side band" shortened to "narrow band," and "wide frequency band" or "wide side band" shortened to "wide band" are more informative in their implications, and will now be used throughout this article.

It is often argued that for successful exploitation television must be developed to a stage at which the detail can compare with that given on a cinematograph film. The conditions, in their correct order, however, which are required to ensure successful exploitation are:—

(1) Interest value.
(2) Public support.
(3) Technical development.

If the interest is there, the public will grow, even although the technical development is not of the highest order. Broadcasting as a movement was made a success in this country not by catering primarily for the users of multi-valve receivers, but for the users of crystal receivers. The crystal user later became the owner of the valve receiver. In a similar way, if the broadcasting authority caters first for the narrow-band enthusiast, a public will be formed which later will take interest in the wide-band programmes.

The interests of narrow-band and wide-band television are not opposed. The systems are actually complementary to each other. Thus, the narrow-band system is suitable for medium-wave transmissions, and therefore can be transmitted over a considerable distance. The choice of suitable subjects is necessarily limited, and should preferably be confined to the head and shoulders type, but a fairly large home screen can be used giving a bright picture, to obtain which a variety of scanning methods are available. As there are many manufacturers able to make such apparatus, the market price should be comparatively low, and within the reach of the man of average means. As the subject must be a simple one, the interest value should already exist in the known personality of the subject or in the message he is able to deliver.



Original photo courtesy Metro-Goldwyn-Mayer.

This picture of Jean Harlow gives an approximate idea of the definition which may be expected from 30-line television where the size of the subject is suitable. Definition improves, of course, with movement. Compare this with the impression on the next page.

Problems of "Wide-band"

Compare this now with the wide-band system, which can only find a space in the ether on ultra-short-wave channels, and therefore must be confined to transmission over moderate distances. The subjects, however, may contain several figures, but although the size and brightness may be adequate the pictures are smaller than can be obtained on the narrow band, and the cost of the equipment, which at present is restricted to cathode-ray apparatus, must limit it, certainly for some years, to the fortunate few. The main interest value is likely to be given by its entertainment qualities, the human reactions between full-length figures, or groups with background effects, or outside scenes such as may be relied upon to create their own interest value.

A national broadcasting authority would naturally desire, however, if at all possible, to provide a television service of some kind for all its licence-holders. The expense of providing special ultra-short-wave stations out of the licence fees for wide-band television enthusiasts would necessarily have to be offset by an endeavour to provide narrow-band transmissions on a medium wave for those of smaller means.

Before commenting on the B.B.C. 30-line transmissions, I should like to emphasise how valuable they have been to all those interested in the development of the art, indicating, as they have done, the lines on which further progress should be made; and it is fitting that the excellent studio technique for obtaining the best photo-cell response to the scanning spot impulses, which has been evolved at Broadcasting House for these transmissions, should also be acknowledged.

The period given for transmission, from 11 to 11.30 p.m., has been the means of discouraging "looking-in," even by many of those interested in television, except on infrequent occasions. If television is to become popular, provision must be made for it in the broadcast programme.

Technically, the pictures have been inferior to what could be obtained with a different picture ratio on the radio-frequency band width employed.

The theoretical maximum fundamental

Broadcast Television—

frequency response required by the 30-line picture circuit is 13 kc/s. The cut-off of the studio line circuit is about 20 kc/s, but the frequency response of the radio transmitter is known to fall off at about 9 kc/s.

Although there is some loss of detail due to uncorrected aperture effect, the correction would not be worth applying having regard to the radio cut-off. The monitor picture in the studio in the case of limited make-up is better than any picture received by radio under most favourable conditions. As the smaller detail of the picture is not transmitted, it follows that to make most use of the frequency band which is available make-up can be employed to eliminate fine detail and increase the detail corresponding to 9 kc/s and less. Thus, in the head and shoulders pictures, the eyes have been given depth by heavy shadows, and more make-up is employed than would be necessary for stage effect. In so doing, naturalness has disappeared, the face has become more static, and the picture has been robbed of much of its interest value. It has been stated that heavy make-up has been used to obtain better results from poor receivers. If true, the principle is a bad one.

It has been a mistake to put over "weak" pictures such as are produced by televising two or even one full-length figure, with no special make-up, by the 30-line scan. There is so much change of detail per picture element that the mean light intensity is not very different from that of the background, with the result that the image appears faint, like a print from an under-exposed film.

As the finer detail is lost, the viewer's attention is attracted to the outline, and, in order to maintain an interest value, this outline must change, and the subject is therefore compelled to move, dance, or distort its shape. This type of picture is too ambitious for 30 lines, and should be cut out of the programme.

When the contrast is obtained by large areas of black and white make-up and there is no fine detail, the human interest value disappears and the picture, therefore, becomes unsuitable.

Making the Most of 30-line

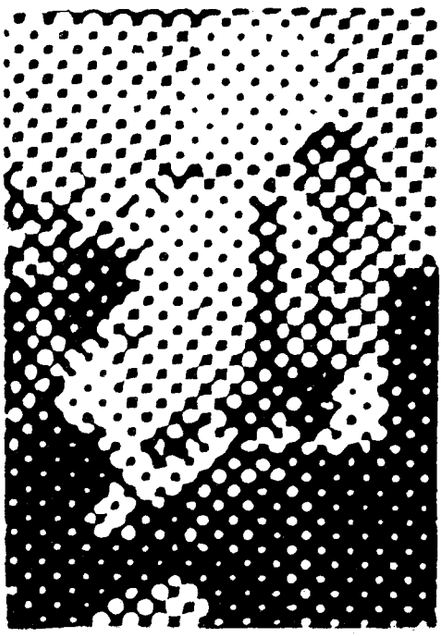
What should be the conditions for successful narrow-band television?

First, the picture requires to be put over so that every single picture element can be reproduced faithfully at the receiver, and therefore the frequency band used must have the width necessary to do this.

Further, if the frequency band cannot for any reason be adjusted to the full width required by the picture, then the number of picture elements must be reduced to correspond to the width of the maximum frequency band available.

If, for the reasons already given, the televising of a full-length subject need no longer be considered, then the picture ratio of 7 to 3 is no longer necessary, and an improved head and shoulders picture can be obtained within the present band width of 9 kc/s.

Thus, a 30-line picture 40 elements long transmitted 12.5 times per second requires a band width of only 7.5 kc/s. We can increase the picture frequency to 15 per second when a 30 × 40 picture will require the full band width of 9 kc/s.



[Original photo courtesy H.M.V.

In this illustration an idea is given of the effect when too ambitious a subject is put over from the studio, i.e., a subject where there is a large amount of detail to which the 30-line system is unable to do justice. It is necessary to view this illustration from some distance to appreciate detail at all.

Alternatively, we can transmit a picture with more lines, such as 34, and if this is 42 elements long, repeated 12.5 times per second, the band width is 8.9 kc/s.

It is convenient to have one dimension greater than the other to accommodate the synchronising signal; also, if the frame is turned so that scanning is horizontal instead of vertical, two heads can be scanned instead of one.

If the subjects are then chosen so that the minimum area of high light required for definition is given by not less than three or four picture elements, then make-up can be dispensed with, or it can be reduced to the minimum necessary for artistic needs.

As regards programmes. Having decided that the transmission will be confined to head-and-shoulders subjects, we have now to decide on those which are most likely to have the maximum interest value; they must be of the type which will enable a strong picture to be put over—that is, one in which it is possible to bring out the high lights and dark shadows. Should anyone doubt that head-and-shoulders television can have sufficient interest value to become popular, they may be reminded that the first film that brought success to the talkies in the United States and this country was the "Singing Fool," a film which put over a catchy song with a large proportion of close-ups showing a single face. It must be remembered, however, that the only appeal that television can claim over other highly developed methods of conveying pictorial intelligence is the natural and life-like character which can be given to the picture, and this appeal vanishes with heavy make-up, which, apart from the opening or closing of the eyes and mouth, removes all expression and vitality from the face.

Subject Matter and Times

The point from which narrow-band broadcast television should preferably start is a head-and-shoulders picture with a personality already publicly known. The announcer would make an excellent subject—a man whose voice is known to every listener, chosen because he has not only the right kind of voice, but, in most cases, the right kind of manner, one, therefore, to whom the viewer is already favourably disposed. Nor is it at all necessary or advisable for all subjects to make up. All talks may thus be considered as subjects for head-and-shoulders television. The authors are usually men and women of note. The listener is interested beforehand in the personality of the broadcaster and would like to view him.

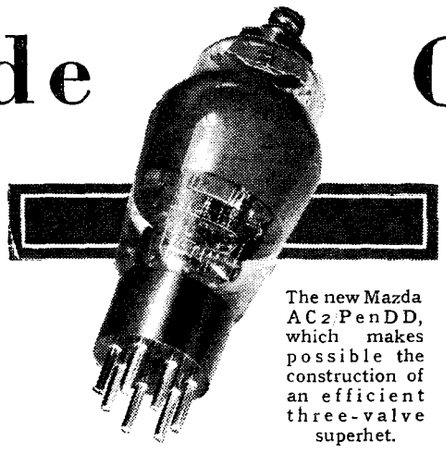
Next, as regards the times of showing. It follows from the type of picture recommended for televising, that the television sessions should take place well in the body of the programme; actually, when the greatest number of people are listening in. It is suggested that sound would be broadcast on the long-wave National, and vision on all the Regionals. Vision in this type of programme would be an accessory to sound and not the principal feature of the broadcast. The removal from the vision service of the responsibility for providing interest value should smooth the way for television, particularly while the service is in its early stages.

So far as the B.B.C. is concerned, there would be a great saving in expense, as no special programmes need be considered. There would be a saving in programme time, as the sound channel would have been in use for the transmission of news or talks in any case. If it be considered necessary, however, to interpolate occasional variety broadcasts in the television programme, these would at best be of a very simple character.

The general public, as a result of these arrangements, would obtain a satisfactory narrow-band picture with as much detail as the method would allow. The cost of the equipment, through competition, should be comparatively low. Listeners would soon become both listeners and viewers until they became television-minded, and then the limitations of the picture subject-matter would act as a direct incentive to them to support wide-band television with its more complex pictures when it finally enters the commercial field.

New Diode Output Pentode

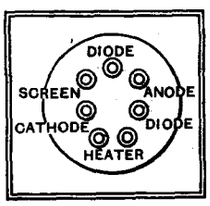
Combined Detector, A.V.C. and Output Valve



The new Mazda AC2/PenDD, which makes possible the construction of an efficient three-valve superhet.

THE diode detector has certainly conferred many benefits upon the modern receiver, among which must be numbered distortionless rectification, a simple means of providing A.V.C. and an input load so small in magnitude that the preceding tuned circuit is but lightly damped. It is seldom, however, that such a formidable list of advantages is not accompanied by a disability in some other direction.

The diode cannot amplify and as a result it has hitherto been found necessary to employ an intermediate L.F. stage, so that there shall be sufficient grid swing to load up the output valve. For convenience of wiring and to conserve space, two diodes—one for rectification and the other for A.V.C.—are usually mounted in the same bulb as the intermediate L.F. valve, and we then have the familiar duo-diode triode or duo-diode pentode.



The pin connections of the valve looking at the base. The cap at the top of the bulb is joined to the control grid.

There has now been introduced a duo-diode valve—the Mazda AC2/PenDD—in which the rectifying diode is arranged to feed an output pentode directly, without any intermediate L.F. stage. The valve is, in fact, a duo-diode output pentode having the remarkably high slope of 8mA. per volt, the amplifying portion being identical with the AC2/Pen. The sensitivity is of a high order, since an undistorted output of about 3,400 milliwatts is obtained for a grid swing of 3.4 volts (R.M.S.).

The more important characteristics are given in the table, from which it will be seen that the heater current is twice the normal value, namely 2.0 amps. There is a standard 7-pin base and top control grid contact, the total number of connections to the valve being the same as those of only one of the two valves which it replaces.

It is due to the advent of this valve that a number of manufacturers are now putting on the market a three-valve superhet. In such a receiver the first valve is a frequency-changer followed by a variable-mu H.F. pentode in the I.F. stage which, in turn, is linked to an A.C.2/PenDD.

AC2/PenDD.	
Heater voltage	4.0
Heater current (amps.)	2.0
Max. anode volts	250
Max. screen volts	250
Anode current (mA.)	32
Screen current (mA.)	6
Mutual conductance*	8
Max. undistorted output (milliwatts)	3,400
Optimum anode load (ohms)	6,500
Input volts (R.M.S.)	3.4

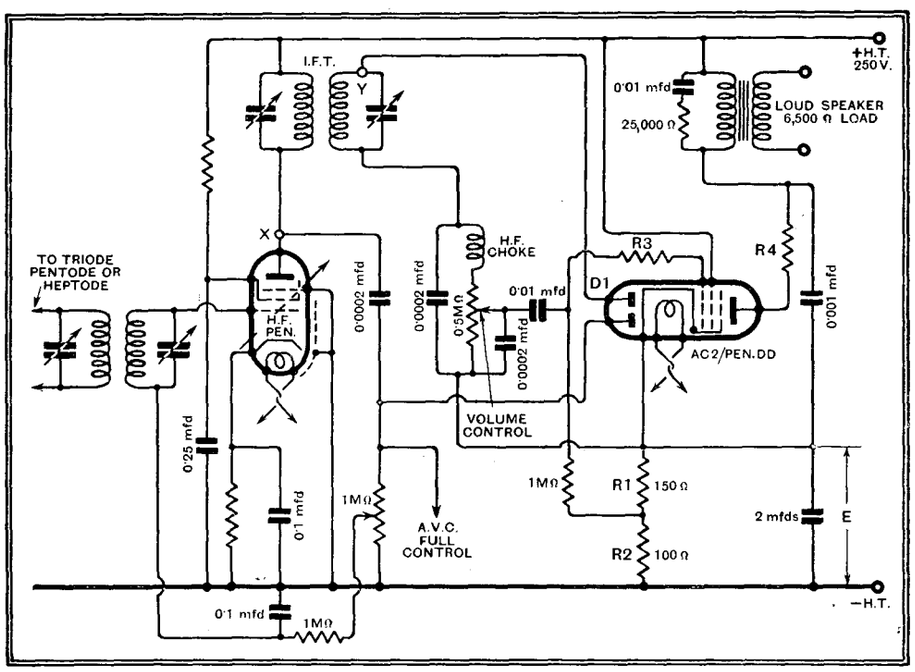
* Taken at anode volts = 100; screen volts = 100; grid volts = 0. The maximum undistorted output is given for the condition that no harmonic component of the anode current exceeds 5 per cent. of the fundamental.

Such a set is capable of a good performance as regards A.V.C. action and sensitivity.

How to Use the Valve

The circuit advocated for the AC2/PenDD is given on this page and shows the popular scheme of half-wave diode rectification with delayed A.V.C., the delay voltage being equal to E (about 9 volts), that is the total pressure developed across R1 + R2, whilst the bias for the pentode depends upon the volts across R1 only, through which flow the anode and screen current (about 38 mA.). To prevent parasitic oscillations a resistance, R3 or R4, of 50 ohms should be attached directly to the anode or grid terminal of the valve holder and, to filter away from the mains equipment the last trace of H.F., a 0.001 mfd. condenser is shunted between anode and cathode of the pentode. An impedance limiter is connected across the speaker transformer primary and the H.F. choke (which must have an inductance of about 300,000 μH) is found to give the best results when joined in series with the diode load, as shown in the diagram, and not in the potentiometer slider circuit. The delay diode load is tapped so as to give a slightly reduced A.V.C. control to the I.F. valve while the early stage is fully controlled. An important feature which on test is found to minimise considerably the "sideband screech" which results from listening to an A.V.C. set slightly mistuned from resonance point is the connection of the delay diode to the primary, and not to the secondary, of the I.F. transformer. The point X is less selective than the point Y.

Attention has been paid to the inter-electrode capacity of the valve owing to the dangers of high-note attenuation due to Miller effect. To derive the greatest benefit from this, all wiring connected to grid and anode should be short and of low capacity to other leads.



Circuit diagram of the new double-diode output pentode valve. The diode D1 feeds the output stage direct without the customary intermediate L.F. stage.

BROADCAST BREVITIES

By Our Special Correspondent

"The Plan" in Retrospect

MR. NOEL ASHBRIDGE, the Chief Engineer of the B.B.C., and Mr. L. W. Hayes are representing the B.B.C. at the Geneva Conference of the International Broadcasting Union. The Conference wears a "morning-after-the-night-before" aspect, for it is the first meeting of technical experts since the inauguration of the Lucerne Plan.

Lucky Britain

The Union has done well to defer the meeting until now; a month ago such a gathering would have been a sorry affair, but the experts can now look each other in the face with the comfortable feeling that things might have been much worse.

The B.B.C., indeed, is quite jaunty on the subject of the Lucerne Plan, as well it may be, for only Daventry long wave appears to be at all troubled by foreign interference.

Television

THE keenness of television enthusiasts has been proved up to the hilt, and I warmly thank the many "televisionists" who immediately responded to my appeal for postcards. I can now state that the B.B.C. has definitely decided not to abolish the 30-line tests, and there is reasonable hope that, in face of the appeals printed on another page of this issue, the officials may recognise that the continuance of the present regime would be the fairest course to adopt.

Wanted: a Guarantee

What is needed is a declaration from the Corporation that whatever arrangements have been made will be continued for a stated period. This assurance would, as letters reveal, awake a wide response among people who, quite wisely, refuse to incur even a small expense unless some definite return can be guaranteed.

These "Anti-Crooners"

THERE is something "Irish" about this anti-crooning business.

Two of the four anti-crooners chosen by Henry Hall to blaze the new trail are Birrell O'Malley and Patrick Colbert. The other two are Dunstan Hart and—who do you think? Les Allen, broadcasting's champion crooner!

Anti-Crooning Quartet

On Saturday, March 10th, the anti-crooners, who will have been singing as soloists, will join in a quartet.

Reginald King's New Vocalist

The decline of crooning has done nothing to diminish the demand for vocalists. I hear that Reginald King, whose orchestra is one of the most popular of its type, will soon bring a singer to the microphone.

Hitherto the orchestra has played its selections throughout an hour's programme without any intervals or interludes, but it is being realised that musicians, like journalists and tax collectors, gain in efficiency if given a short breathing space.

Reginald King's new vocalist will sing selections interspersed throughout the programme.

America's Silence

THE B.B.C. is mystified. While plunging its great big official hands through stacks of American press cuttings, it has its ear to the transatlantic cables and the wireless terminals.

What it cannot understand is that America should still be silent in the face of that scathing retort in the "Listener" to American criticisms of B.B.C. policy. America seems to be indifferent, but there is still one hope left: perhaps she is stunned!

Sunday Rehearsals

HOW many people realise that Sunday in Broadcasting House is taken up with rehearsals just as any other day of the week? Members of the Wireless Military Band rarely have an opportunity to go to church on Sunday, whether they wish to or not. The fact was brought to my notice last week by a B.B.C. official's chance remark that it was fortunate that the Wireless Military Band was rehearsing on Sunday, February 18th, the day when the tragic news arrived of King Albert's death. It was the Military Band that played the "Dead March" that evening.

A Busy Day

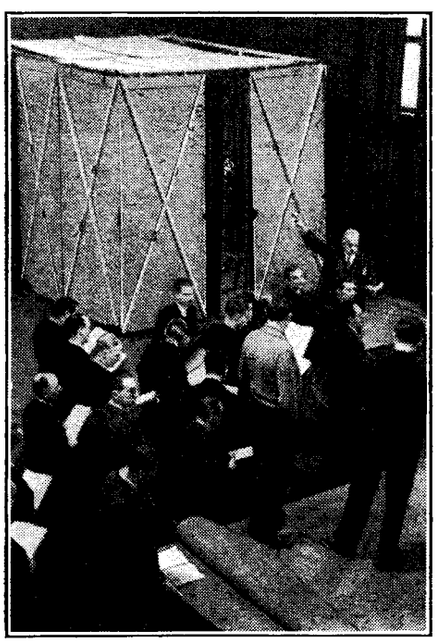
Symphony orchestra rehearsals are frequently held on Sundays either in "No. 10" studio (the old warehouse is still used for rehearsals) in St. George's Hall, or in one of the Broadcasting House studios.

The B.B.C. insists that orchestras shall be rehearsed "up to the minute."

Elgar's "Unfinished"

THE death of Sir Edward Elgar means that the Symphony which he was composing for the B.B.C. will never be performed. The work had been begun, but had not reached the stage at which it could be taken over by some sympathetic editor and prepared for performance. I understand that "The Master of the King's Musick" had planned the work but had not had time to orchestrate it; and no one would dare to fill in the gaps. There has been only one Elgar.

Even now it may be possible to rescue from the manuscript some fragment of beauty which the B.B.C. could justly lay claim to and use as the Master's swan song.



STUDIOS IN STUDIOS. A scene at the Berlin Station during a recent dramatic Broadcast. Note the impromptu studio erected in the background for changes of "scene."

At the Grand Hotel, Eastbourne

LESLIE JEFFRIES has been appointed to succeed Tom Jones as leader of the orchestra at the Grand Hotel, Eastbourne, and he will broadcast for the first time in his new capacity some time in April. Mr. Jeffries, a Londoner by birth, was trained at the Royal Academy of Music, and has been until recently with the orchestra of the Gordon Hotels in London.

He first broadcast many years ago from a Glasgow studio. Listeners last heard him with his Royal Hungarian Orchestra (as Valdenaro) as recently as February 14th. He is broadcasting again on March 19th.

Tobias Matthay in the Studio

IF the state of his health permits, Tobias Matthay, doyen of pianists, will broadcast a recital in the National programme on March 11th. Matthay's writings have revolutionised piano teaching all over the world. He was born in London in 1858, and became a Professor at the Royal Academy of Music more than fifty years ago.

"Tea Mixture" To-morrow

"TEA MIXTURE" will come on the air to-morrow afternoon for the first time, under the direction of Charles Brewer, the compère being Teddy Williams.

"Tea Mixture" revives, to some extent, the idea of the "First Time Here" programmes of last autumn, although not all of the appearances will be first broadcasts.

Mr. Seumus Clandillon

THE forthcoming departure of Mr. Seumus Clandillon from his present post as Director of Broadcasting in the Irish Free State will remove one of the pioneer figures in the sphere of broadcasting. Mr. Clandillon was "lent" by the local Government department to the Post Office nearly ten years ago when 2RN, Dublin, was established; now he is returning to his department.

A Friend of the B.B.C.

In the very early days of broadcasting Mr. Clandillon held a post at Savoy Hill. Since then he has always worked in close friendship with the B.B.C., and has visited the Belfast studios on many occasions. Indeed, the broadcasting relationships between Great Britain and Southern Ireland have been one of the happiest features of history in these Islands in the last ten years.

NEWS of the WEEK

Current Events in Brief Review

300 per Hour

SOME 300 new listeners per hour took out radio licences in Germany during January. The total increase for the month was nearly a quarter of a million.

Four Months After

FOUR months after the inauguration of a wireless licence system, the registered listeners in Portugal now number 17,000. There are believed to be many more "pirates."

Measuring Noise

THE measurement of noise is to be the subject of a lecture to be given before the Institution of Electrical Engineers on March 8th by Mr. B. A. G. Churcher, Mr. A. J. King, B.Sc., and Mr. H. Davies. Special reference will be made to the problems of noise in machines.

An Expensive Change-over

GERMAN radio dealers are forbidden to make a free exchange of tuning dials in connection with the Lucerne Plan. According to the rules of the radio trade, the new dials and the time taken in fitting them must be charged for at a predetermined rate. In most cases the cost is in the neighbourhood of ten shillings.

Standard Frequency Transmission

SHORT-WAVE users will be interested to know that the next quarterly transmission from the National Physical Laboratory, which takes place on March 6th at 21.00 (G.M.T.), will be on a frequency of 1,780 kc/s instead of on 1,785 kc/s as hitherto. This is a more convenient frequency for many experimenters.

Practice Morse

THE P.M.G. has just authorised slow morse transmissions under the auspices of the R.S.G.B., and three members, one in North Wales and two in London, are sending practice messages for the benefit of learners, on 160, 80 and 42 metres. Full details as to times and exact frequencies can be obtained from T. A. St. Johnston, 28, Douglas Road, London, E.4.

On the Longer "Shorts"

IN an effort to prove that radio conditions are now at their best on the 1.75 m/c band (170 metres) several members of the R.S.G.B. Experimental Section have been endeavouring to establish transatlantic communication on this, the amateur transmitter's longest waveband. Some half a dozen different U.S. stations have been heard during the past weeks and, in addition, Mr. D. Low, G5WU, of Penarth, South Wales, has actually made two separate contacts with the States. He was using only 10 watts input whereas the power used by the Americans ran to several hundreds of watts.

Coveted Millions

BITTER things are being said in French theatrical circles concerning the "millions" devoted to French State radio development. On the door of one of the offices of the Paris PTT station somebody last week chalked the word ELDO-RADIO.

Radio Discs

WIRELESS licence discs are now the rule in Switzerland. The disc, which is fitted to the control knob of the wireless receiver, indicates to visitors, official or unofficial, that the licence fee has been duly paid. It is considered bad form not to sport a disc.

Radio in the Navy

"THE Reception of Wireless Signals in Naval Ships," is the title of a paper to be read by Mr. W. F. Rawlinson, D.Sc., before the Wireless Section of the Institution of Electrical Engineers at 6 p.m. on March 7th.

New Wavelength Plan: Synchronised Working?

TESTS to ascertain the possibility of operating all the high-power stations in Germany on a single wavelength were described in a recent lecture by a director of the Lorenz Company in Berlin. The lecturer showed that such a system could be achieved. It is understood, however, that the time is not considered ripe for the introduction of the system because it would mean freeing wavelengths for other countries!

At the next European Wavelength Conference, which will probably be held next year, a new wavelength scheme may be evolved providing for high-power single wavelength working throughout Europe.

Opinion in the Fatherland considers that while such countries as Great Britain and Germany could adopt the system, it would be impracticable in France and Spain, where technical skill in precise wavelength working is lacking.

SPAIN TELLS THE WORLD. Señor Ramon Gomez de la Serna, who provides weekly commentaries on current events at the Madrid (E.A.J.7) microphone. He is here seen in the talks studio.

More Amateurs in Germany

SINCE the Nazi Government removed the restrictions on amateur transmission in Germany last May, no fewer than 400 new transmitting licences have been issued.

Interference "Scandal"

THE contention that the B.B.C. should pay for any anti-interference measures which the Sheffield Tramways might undertake was put forward at the City Council meeting last week by Councillor A. Oates, Deputy-Chairman of the Tramways Committee. In reply Councillor F. Lloyd said that it was a scandal that unnecessary interference with wireless reception in Sheffield should be caused by a public department like the tramways.

Meanwhile, the crackles continue.

2,000 Pictures a Second

A MOTION picture camera capable of taking 2,000 pictures per second, and recording time as well, is the latest achievement of the Western Electric Company.

During recent laboratory experiments the shattering glass of an electric light bulb resembled slowly drifting snowflakes under the photography of this high-speed camera. It also revealed to a leading motor manufacturer a defect which had jeopardised one of the most important parts of the mechanism.

The time is recorded by a precision electric clock driven by a current generator which consists of an electrically actuated tuning fork.

The clock comprises three concentric revolving discs giving the time in minutes, seconds and hundredths of seconds. The image of these discs is recorded simultaneously on the film with the movement of the image.

The complete unit weighs only 28lb. and it can be mounted on a tripod.

Television Demonstrations

TELEVISION reception of the B.B.C. 30-line transmissions is demonstrated by the Edison Swan Electric Co., Ltd., at their Ponders End works. Readers interested may be accommodated by appointment and applications should be made to the company's Radio Division, 155, Charing Cross Road, London, W.C.2.

Radio Piracy in Italy?

THE number of wireless licences in Italy on January 1st was officially announced as 370,000, an increase of over 65,000 over the figures for the preceding year.

Considering that Italy has a population of about 42,000,000, approximating to that of England and Wales, her licence figures are relatively low. It is believed that there are many unlicensed listeners.

Desperate Case

THE resourcefulness of wireless pirates when confronted by a magistrate is proverbial, but the limit seems to have been reached in a case at Hjorring, Denmark. A listener who had been found guilty of several years of wireless "piracy" was fined 40 kroner. He declared that to pay the licence fee he would have to sell his receiver. But having no receiver he could not pay the fee, but if the magistrate insisted upon his being fined he would go straight home and hang himself. The magistrate insisted on payment at once, and, according to our Danish correspondent, Scandinavia is still eagerly waiting to read of the first martyr-pirate.

Interference

THE first meeting of the newly formed Commission for the suppression of electrical interference with broadcast reception was held on February 19th at the Ministry of the French Posts and Telegraphs in Paris. According to an official report, which appears to be written in true "committee" fashion, the meeting revealed "a keen desire for collaboration to reach practical results as rapidly as possible. The Committee, because of the considerable number of cases to be dealt with, has decided not to wait for the results of a necessarily long period of working and has decided to adopt at once the first measures for dealing with the worst cases. . . . All the necessary steps have been taken for the immediate commencement of the work. . . ."

This is a good beginning and we trust that the optimism will be justified.

Page 151 follows after the Programme Supplement

Television: 30-LINE TESTS *ARE* WANTED

THE disclosure by our Broadcasting Correspondent that the B.B.C. proposes to limit the 30-line transmission tests to two per week has evoked protests from television enthusiasts all over the country. The following are selections from a few of the very many letters and cards received

"I HAVE been a regular 'looker-in' to the B.B.C. 30-line transmissions for the past thirteen months, and am very sorry to read that our programmes are to be cut down to two a week. If this is true, I hope the programmes will be longer and include one on *Saturday* evening."—F. S. E. Andrews (Waverley Park, S.E.15).

"I have been receiving television transmissions for nine months and have obtained excellent results. In all fairness to the amateurs who have spent so much time and cash on their present apparatus, I don't think the B.B.C. should cancel the 30-line transmissions yet."—J. Smith (Woolwich).

"I think it would be a pity to abolish 30-line tests just yet with 120-line transmission still in its babyhood."—"Eager" (Rugby).

"If it could be definitely decided what standard as regards strip and picture frequency (say, for the next two or three years) would be adopted, there is no doubt that people would install television sets, not only for experimental purposes but for their entertainment value."—C. V. Fowkes (London, N.2).

"Since transmissions have been on 261 metres at night I have given it up, as reception here is too unsteady to be worth the trouble." — H. O'H. Moore (Parkstone, Dorset).

"We need a Scottish transmission. I receive the transmissions on a disc machine and am about to build a cathode ray receiver."—W. Dargavel (Glasgow, S.4).

"I have been picking up the 30-line transmissions for some months, and it's great fun. But why wait till 11 o'clock? And were we not promised illustrated news bulletins? Hoping you're snowed under with these cards. . . ."—H. W. C. Nichols (Leytonstone, E.11).

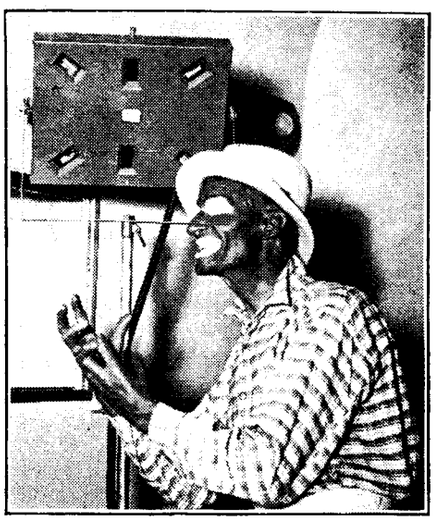
"Although we are *two hundred* miles from London National we can usually see *seventy-five* per cent. of the transmissions fairly well, the balance being lost through fairly rapid fading."—W. Stanley Atkin (Wallasey).

"I regularly receive the 30-line television broadcast by the B.B.C. . . . The full fare as at present transmitted is quite satisfactory if one is content with a small image." —F. H. Dixie (Bournemouth).

"As an old television enthusiast it is most disappointing to learn of the B.B.C. attitude of cutting down the 30-line transmission. . . . If we are to have fewer television programmes it is hoped that the B.B.C. will consider putting the vision through a better station, even if we have to wait till a later hour."—K. M. Button (Breaston, near Derby).

"If the new experiments are to help in the future let the B.B.C. close down completely for a bit and get on with it."—I. P. Grant (Bournemouth).

"I should like the B.B.C. to stop the 30-line broadcast *if* they will broadcast on 120 lines on 6.1 metres and install, say, five small transmitters in various parts of the country, even if it means that the owner of a television set paid a pound a year for a licence. I, for one, would pay it gladly." —E. J. Anderson (Wilmslow, Ches).



A typical television "turn." The actor is Fred Douglas, made up and attired to give an image with wide contrasts of light and shade. Items of this kind can provide genuine entertainment value on 30-line transmissions.

"I sincerely trust that the transmissions will not only continue, but at the earliest possible date emanate from more and nearer aerials. When a Scotsman is sufficiently extravagant to expend 1½d. in P.O. fees for a letter containing his views on any matter, his opinions are sincere."—Jas. Gouck (Kirkcaldy, N.B.).

"I happen to have just ordered certain parts for a mirror screw."—C. Hopkinson (Wharram, Yorks).

"What is the use of concentrating on 120-line transmissions with ultra-shorts when the only people who have any hope of receiving these transmissions are those who live in near proximity to the Crystal Palace?" —N. M. Watson (Widnes, Lancs).

"For the past year I have been looking-in to the 30-line transmissions with a disc scanner of my own make and get very good results."—C. H. Oldfield (Coxhoe, Co. Durham).

The B.B.C.'s new television headquarters at No. 16, Portland Place. Broadcasting House is a few doors to the right.

"In view of the fact that we are experiencing the utmost difficulty in obtaining supplies in sufficient quantities to satisfy our numerous 'television' customers in this district, and that dealers from all parts of the North of England are asking us daily to supply them in large quantities with a 'television kit' which we are marketing, we read your remarks in the issue of *The Wireless World*, dated February 16th, with a certain amount of amusement. . . . Television has come to stay, and its development will be the more speedy if amateurs in the North are given a transmission worth working on."—E. Colmar Wood (Radio Equipment Co., Chester).

"These transmissions are of inestimable value to a larger body of enthusiasts than you apparently imagine, and I hope they will all come forward to prove it to you. . . . If a change must be made in the transmissions I would suggest that the B.B.C. send out television for periods of at least one hour on, say, two nights per week in preference to short half-hour periods on four nights per week, as at present. This would be much more helpful for experimental purposes."—Hugh J. Miller (Linlithgow).

"I work a 30-line televisor every evening the B.B.C. transmits, using home-constructed apparatus, and have been experimenting since 1928."—F. E. Gay (Grays, Essex).

"I have been picking up the 30-line television transmissions now for two years. . . . The points, to my mind, that are likely to

Television—

prevent a larger audience than at present are, first, the late hour of transmission, and, secondly, the uncertainty as to the nature of the future transmissions."—E. A. Williamson (Derby).

"I consider that the entertainment value of the programmes, entirely apart from technical interest and novelty, is low. . . . At the moment any improvement in results seems to be impossible here until satisfactory synchronising has been obtained."—G. D. Dawson, Jnr., M.Sc. (Wilmslow, near Manchester).

"For a public demonstration of cathode ray television at our society headquarters we were optimistic enough to provide seating accommodation for eighty. Over two hundred people were crammed into the room, standing on the window-sills and every available perch, a group even watching the image from the back of the tube! And, even then, we had to turn away nearly another one hundred. . . . Is it (30-line television) any cruder than sound radio was in 1923, with our tin trumpet loud speakers and 'high-mag' valves used in the output stage?"—E. H. Ware, Programme Secretary (Exeter and District Wireless Society).

"My viewer cost me only about £2, as most of the parts—transformer, resistances, holders, metal, and other odds and ends—came out of the wireless junk box, and as I run my motor off the mains operation is easy and cheap. I don't think enough people realise how cheaply and easily the vision programmes can be received. . . . I hope 30-line tests will be continued."—Matthew H. Blamey (Sutton, Surrey).

"As I see it, the main justification for the present policy lies in the experience it gives the B.B.C. staff, not only on the technical side—which may soon be revolutionised—but in the choice and presentation of suitable programmes, and, generally, in the development of the new technique associated with television."—F. H. Woodbridge (Cambridge).

"We cannot hope for a chain of ultra-short wave transmitters over the country for several years yet, and so, to give just one argument, if television is to be prevented from dying out completely in the country as a whole, low definition medium-wave transmissions must continue; and, may I say, 30-lines is not such low definition as some people imagine."—P. H. Walker (Streatham, S.W.16).

"You may like to know that my apparatus, home built, cost under £1 and yet is capable of giving small pictures of people which are easily recognisable from photographs."—C. T. L. Hare (Tunbridge Wells, Kent).

"The restriction of the 30-line transmissions to two nights a week appears to me to place a definite bar on the general public becoming television-minded. Might I suggest that the twice-weekly transmissions be of an hour's duration. This would to some extent meet the B.B.C.'s case and would afford a far better opportunity to those interested."—L. W. Wheatley (Cambridge).

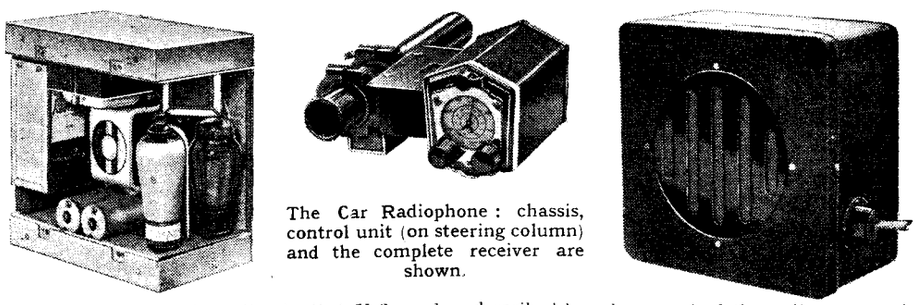
"About a month ago I rigged up a disc receiver in the simplest possible way in order to see whether reception was worth while at all at such a distance from the transmitter, and the results have been so encouraging that I have felt it worth while to go ahead and add such things as synchronising gear to the motor."—A. J. Veitch (Edinburgh).

THE RADIO INDUSTRY

TWO exceptionally interesting receivers are exhibited at the British Industries Fair, Olympia (which closes to-day) by British Radiophone, Ltd., of Aldwych House, Aldwych, London, W.C.2. The first is a four-valve motor car set, which differs from all others of its type in that the "control head" contains the tuning system—miniature ganged condensers and iron-cored coils—as well as wave-range switching and volume control, etc. Therefore it will be seen that the set proper, which may be mounted in any convenient position, is electrically remote-controlled; all other sets are either directly controlled or, more usually, operated through a mechanical remote control.

The "Car Radiophone" includes an 8-in. speaker and a self-rectifying vibratory H.T. generator. Total consumption from the car battery is given at 42 watts, the speech output being 2 watts.

The second new Radiophone receiver is an all-wave superheterodyne, intended solely for overseas use. Wavelengths between 10 and 2,000 metres are covered, and a total of seven valves are employed in an interesting circuit with refinements such as "quiet" A.V.C. and a heptode frequency changer. Another model, covering short and medium waves, is also available.



The Car Radiophone: chassis, control unit (on steering column) and the complete receiver are shown.

The makers of the Radiolab test unit announce that they have outgrown their organisation at St. Albans, and in future the business will be carried on in a special Radiolab department of Everett, Edgecumbe and Co., Ltd., of Colindale Works, Hendon, London, N.W.9.

Two Ferranti battery-fed superheterodynes, one an open aerial model and the other a portable, have just been released.

A new Ever Ready H.T. battery, Type No. W.1252, has been produced especially for the latest McMichael Lodex 5 receiver.

A well-prepared catalogue, entitled "Technical Summary of Precision Apparatus for Radio- and Audio-Frequency Laboratories," has just been issued by H. W. Sullivan, Ltd., of Leo Street, Peckham, London, S.E.15. The apparatus described, among which are included wavemeters, standard inductances, H.F. and L.F. oscillators, etc., is of great interest to technical workers.

Henry Ford Radio, of 56, Howland Street, Tottenham Court Road, London, W.1, undertake the servicing of American receivers of all types, and have a stock of American components, speakers and valves. This firm is also equipped to undertake the repairing and adjusting of "Wireless World" receivers.

Halford Radio, Ltd., of 39, Sackville Street, London, W.1, announce the adoption of a new distribution policy, and consequent reductions in price of their receivers, radio-gramophones, remote controls and other apparatus. An attractive conversion scheme, whereby modern improvements can be added to their receivers, has been inaugurated.

A new Dubilier electrolytic condenser for grid-circuit decoupling is shown at the British Industries Fair. Designed for working at 25 volts, with a capacity of 25 mfds., this condenser is of the tubular type, being fitted with soldering tags at each end in place of the usual leading-out wires. Another electrolytic condenser, with 4- and 8-mfd. sections in a common cylindrical container, is designed for 500 volts max., and should have many applications. Both these condensers are at present available only to set manufacturers.

Watmel's are showing at the B.I.F. a new type of heavy-duty potentiometer intended for television and similar purposes.

CLUB NEWS

Radio on Mount Everest

The Ilford and District Radio Society has enjoyed the proud distinction of hearing the first lecture to be given by Mr. David S. Richards on the subject of "Radio on the Mount Everest Expedition, 1933." Illustrating his remarks with over a hundred lantern slides, Mr. Richards, a past Secretary of the Society, described how he organised the radio communications on the Expedition, how the Post Office at Darjeeling was converted into a radio station, and how messages were transmitted to the climbers ascending Mount Everest 115 miles away. The messages sent from the camps were coded and forwarded to London within twenty minutes. Hon. Secretary: Mr. C. E. Largen, 44, Trelawney Road, Barkingside, Ilford.

Still Going Strong

A knock-out tournament of loud speakers was held recently by the Croydon Radio Society, the aim being to find a loud speaker capable of putting up a reasonable performance against the Baker moving-coil adapted by Mr. G. S. Vellacott, the vice-president, to his own requirements, and using 12 watts for energisation and several novelties in cone construction. Excitement waxed strong as, one by one, the competing loud speakers were heard behind a screen. In the final round the verdict was obtained by the vice-president's instrument. Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Short-wave Listening in Manchester

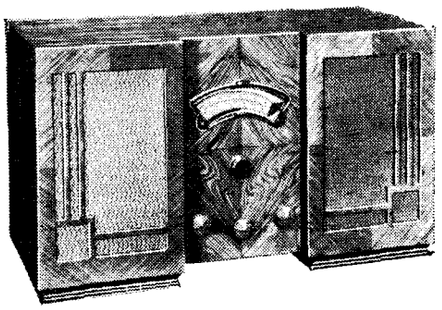
Members of the International Short Wave Club, Manchester Chapter, who have been specially listening on and around the 49-metre band during January, reported at the last meeting that WSXK, on 48.86 metres, was the most consistent station heard. Special listening during February was carried out on the 20-25-metre band. The next meeting will be held on March 6, at 8 p.m., at 75, Long Street, Middleton, near Manchester. The meetings are open to all radio enthusiasts. Hon. Secretary: Mr. R. Lawton, 10, Dalton Avenue, Thatch Leach Lane, Whitefield, near Manchester.

A Television Evening

Television is to be dealt with at the meeting on March 9 next of the Radio, Physical and Television Society, which has headquarters at 72a, North End Road, West Kensington, W.14. Particulars of the Society can be obtained from the Hon. Secretary, Mr. F. J. Bubear, 67, Nassau Road, Barnes, S.W.13.

C.A.C. "AUSTIN" Receiver

A Four-stage Superheterodyne with Dual Loud Speakers



FEATURES. ***Type.***—*Table-model superheterodyne for A.C. mains. Automatic volume control and twin loud speakers.* ***Circuit.***—*Band-pass input to heptode frequency-changer—variable-mu pentode I.F. amplifier—duo-diode-triode second detector—pentode output valve. Indirectly heated full-wave rectifier.* ***Controls.***—*(1) Tuning. (2) Volume control and on-off switch. (3) Tone control. (4) Wave-range.* ***Price.***—*18 gns.* ***Makers.***—*The City Accumulator Co., Ltd., 18-20, Norman's Buildings, Central St., London, E.C.1.*

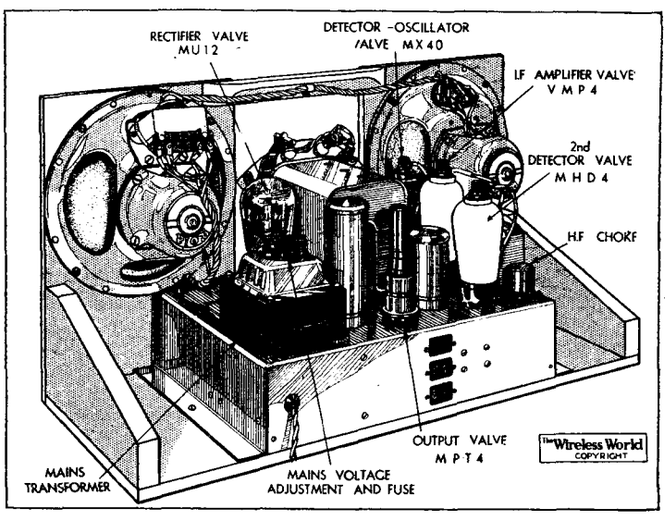
THIS receiver has not been produced with the idea of competing with sets in the large class of four-stage superheterodynes ranging in price from £12 to £14. Although the number of valves is the same, a number of refinements have been included which have resulted in a performance much above the average for the number of valves used.

A band-pass filter with inductive link coupling introduces the signal to the frequency-changer, which is one of the new Osram MX40 heptode valves. High-efficiency air-cored coils have been used in all H.F. and I.F. stages, and shaped vanes are employed in the oscillator section of the tuning condenser. The intermediate frequency is 110 kc/s, and the I.F. transformers are adjusted to give a peak separation of 8 kc/s. It is claimed that the dynamic resistance of these coils is 200,000 ohms, and that the stage gain of the frequency changer, which has an exceptionally high conversion conductance, is about 46. The I.F. valve is of the variable-mu pentode type and the screen is fed through a series resistance in order to extend the grid base so as to obviate distortion and overloading.

The second detector is a double-diode-triode, one diode being fed from the anode of the I.F. valve to provide delayed A.V.C. and the other to the secondary of the output I.F. transformer for signal rectification. The diode load is comparatively low to avoid distortion of deeply modulated passages, and the output to the triode portion of the valve is well filtered.

The volume control operates both on radio and gramophone, and the radio side is short-circuited while records are being played. A filter-fed transformer couples the triode amplifier to the output stage, which employs a three-watt Catkin pentode. Terminals for a high-impedance external loud speaker are fed through a condenser from the primary winding of the output transformer to the dual loud speakers, whose speech coils are connected in parallel. One field winding is used for smoothing and the other is connected in parallel with the H.T. supply, padding resistances being employed to balance the field currents in each. The rectifier valve is of the indirectly heated type which avoids the imposition of excessive voltages on the smoothing condensers while the valve filaments are warming up.

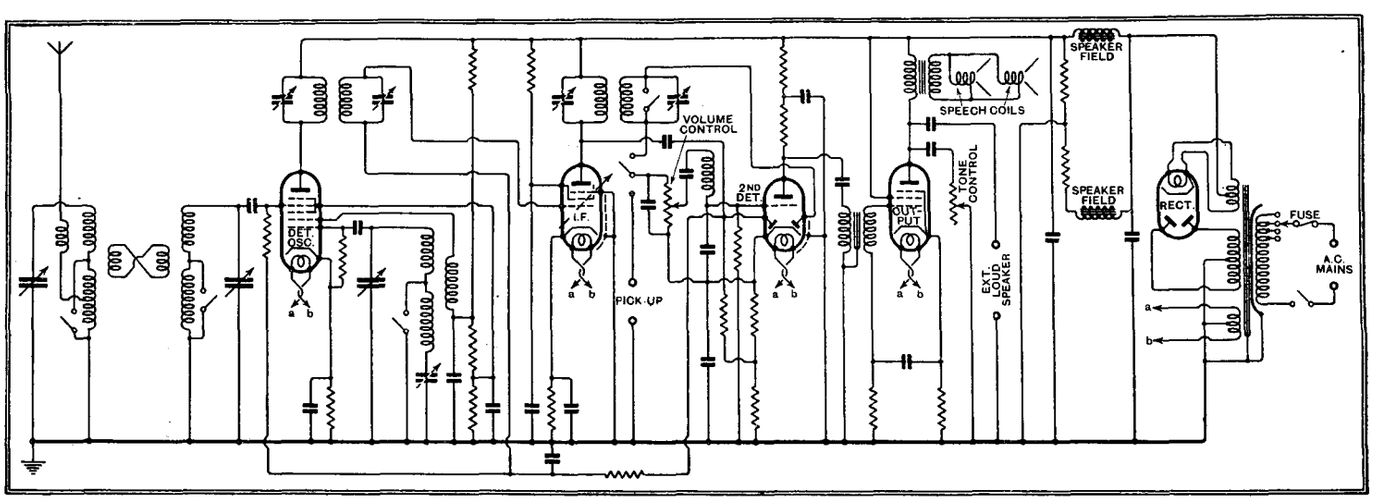
The twin loud speakers and the receiver chassis are built into a single unit which can be readily withdrawn from the cabinet for inspection. The underside of the chassis is cut away, giving easy access to components under the base. All the decoupling and load resistances, together with many of the by-pass condensers, are assembled on a single panel which greatly facilitates testing and servicing. A very interesting feature of the chassis is the neat mains voltage adjustment. The fuse is incorporated in the shorting plug, which pivots in a central socket on top of the transformer. A paxolin disc with a small window is turned until the appropriate voltage is shown, when it is only necessary to plug the fuse into the socket so exposed.



The twin loud speakers are mounted together with the chassis to form a single unit.

From the point of view of sensitivity this is one of the best four-stage superheterodynes we have yet tested. It is not so much that the range is noticeably greater than that of the average sets of this type, but that those stations which are received are of much greater volume and programme value.

In Central London the band width occu-



Automatic volume control and the latest type of heptode frequency-changer are features of the circuit.

C.A.C. "Austin" Receiver—
pied by London Regional was 63 kc/s and by London National 46 kc/s. No difficulty was experienced in separating Königswusterhausen and Daventry on long waves.

Mains hum is negligible, and the reproduction has the full, round quality characteristic of dual loud speaker units. There was, perhaps, a little too much bass for natural speech, but we understand that the receiver tested had two standard units and that in the production models loud speakers specially wound to match the output valve will be fitted.

The "Austin" receiver, while it is not exactly hand made, is obviously built with more individual attention than the cheaper mass-production sets, and the large number of foreign stations of genuine programme value should commend it to those who take a regular interest in distant reception.

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Call-bell System

A CORRESPONDENT enquires whether it would be possible to arrange a microphone and amplifier in such a way that an electric bell would be rung at a distant point when sound waves impinge on the microphone.

Provided that prolonged and sustained sounds will be available for actuating the alarm, it should be possible to devise a practical scheme of the nature that our correspondent has in mind. We suspect that our querist has in mind the use of the device as a "Baby Alarm," and, without claiming special knowledge on the subject, expect that the infantile S.O.S. will satisfy these requirements!

The apparatus should be arranged as in Fig. 1, from which it will be seen that a relay is used to operate the contacts of the electric bell circuit. The output valve, which should be of the comparatively high-impedance type, is biased to act as an anode bend detector. Matters must be so arranged that the anode current flowing through the relay winding is normally insufficient to close the contacts. Magnified impulses from the microphone will bring about a rise in current; the contacts, if suitably adjusted, will close, and the bell will ring.

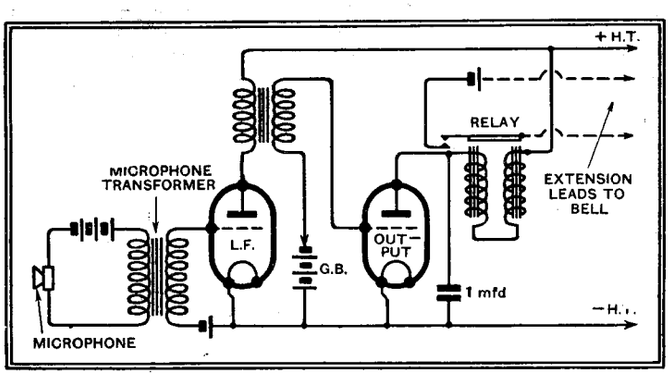


Fig. 1.—A new type of domestic alarm signal, suggested by a reader.

No Cure

WE are asked to say whether the use of a frame aerial is likely to afford any relief from severe electrical disturbances. From the querist's description of the trouble, it seems fairly certain that the interference is radiated from the electric light wiring.

If our assumptions as to the source of the interference are correct, it may be stated quite definitely that a frame aerial is not likely to help. Rather is it to be expected that it will accentuate the trouble, for the reason that, being virtually surrounded by a network of wiring which is radiating interference, it will be affected to a greater extent than an outside aerial.

Nevertheless, a frame aerial is sometimes beneficial in silencing direct interference, especially if the best use be made of its directional properties.

Car Radio and the Home Set

A RATHER interesting experience is described by a reader who has recently installed a receiving set in his car. Taking into account the smallness of the roof aerial, reception is highly satisfactory, and relatively free from background noise. The surprising thing is that in this latter respect the car set, when operated in the garage adjoining the house, has a distinctly quieter background than an A.C. mains superheterodyne which is in use as a domestic receiver. By making careful tests in other localities it has been proved that the superheterodyne itself is free from blame, and that the interference must be due to local causes. What puzzles our correspondent is that this interference does not affect the car set equally, as it might be expected to do in view of the fact that the aerial runs directly over the garage.

The only fair basis of comparison in a case such as that described is the relative noise-to-signal ratios of the two receivers. If we can take it that the proportion of background noise to signal is definitely greater with the domestic set than with the car set, then we have a good case for assuming that the interference is almost certainly re-radiated from the household domestic wiring to the aerial down-lead, or is transferred to the set directly through the mains connection.

This seems to be a clear case for trying the effect of an anti-interference filter in the mains leads, or, alternatively, for fitting a screened down-lead. Normally, one would expect a car set to have a noisier background, due to the fact that the small signal pick-up of the aerial will necessitate a relatively large amount of magnification.

But it Works

A READER who asks for information on the use of a mains aerial, seems to be under the impression that this form of collector may be regarded as an alternative to a good outside aerial. Actually, we think it would be more correct to consider it as an unsatisfactory makeshift, only to be used when nothing better is practicable. The mains aerial consists of nothing more than a condenser of 0.0001 mfd. or smaller, joined between the aerial terminal of the receiver and one side of the mains. It is rather surprising that such an arrangement works at all, but although it is notoriously uncertain in its action, it has undeniably the power of "picking up" signals with fair effectiveness in certain circumstances. It is not surprising, however, that modulation hum is often introduced by its use.

Coils and Condensers

THE combination of a coil and condenser, which we generally refer to as a tuned oscillatory circuit, is a very important unit of any receiver, and the characteristics of either component part have an important bearing on the functioning of the whole. A good coil is not of much use with a bad condenser, and *vice versa*.

A correspondent, who is disappointed at the result of fitting iron-cored coils in his receiver, has, we think, overlooked this point. The coils that he has chosen are among the best obtainable, but the ganged condenser used for tuning is of an out-of-date pattern, and we think it is most unlikely that its sections are matched with sufficient accuracy for this purpose. Minor errors in alignment, which would pass unnoticed with high-resistance tuning coils, become painfully evident when low-resistance windings are substituted.

BOOK RECEIVED

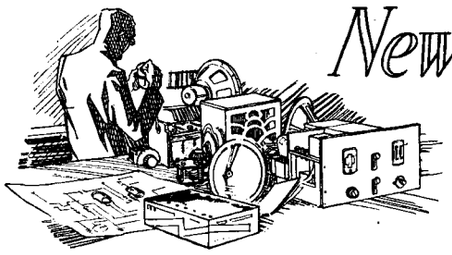
The Romance of the Flying Mail.—A Pageant of Aerial Progress by H. Harper and R. Brenard.—An account of the growth of commercial air service and the Empire Air-Mail organisation from the early experiments with Montgolfier's hot-air balloon to the present time, and including the early flights of pioneer aeroplanes, stories of the first air-mail services, planning and organising the aerial services to India, South Africa, etc., the control of air traffic and descriptions of various flights. Pp. 240+xvi, with 24 whole-page plates. Published by George Routledge and Sons, Ltd., Broadway House, 68-74, Carter Lane, London, E.C. Price 10s. 6d.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.



New Radio Products Reviewed

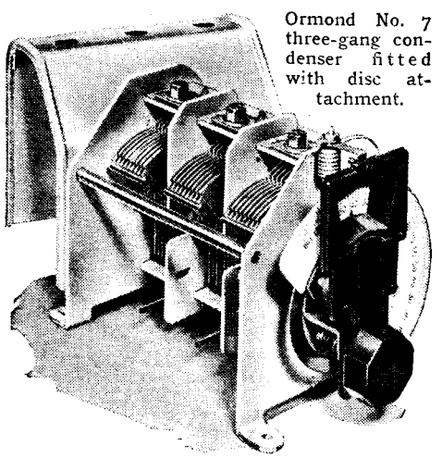
Latest Products of the Manufacturers

ORMOND GANG CONDENSER

THE frame of the Ormond three-gang condenser is assembled from stout steel pressings securely interlocked and well braced to give rigidity, while the vanes are cut from a heavy gauge of aluminium and mounted on a ½-in. diameter shaft in which a loose spindle, adjustable for length, is fitted. The spindle can be inserted from either end, for right or left-hand drive, or another condenser, such as a short-wave type, could be ganged with the main tuning member to provide facilities for all wave reception.

Contact is made with the rotor spindle at two points, and each stator section embodies a small trimmer, which, with the condenser fixed by the feet provided, becomes adjustable from the top. If necessary, however, the condenser can be mounted on its side, and four fixing holes are allowed for the purpose.

The matching of the sections, which incidentally are all of equal capacity, namely, 0.0005 mfd. nominal, in the specimen tested was very good indeed. Over the first half of the range all three sections remained dead in step, then small discrepancies began to appear, but they did not exceed one per cent. up to the 160 mark on a 0-180 degree dial. At maximum capacity the greatest difference was only 1.4 per cent. On the whole the average discrepancy was about 0.7 per cent., which is most satisfactory.



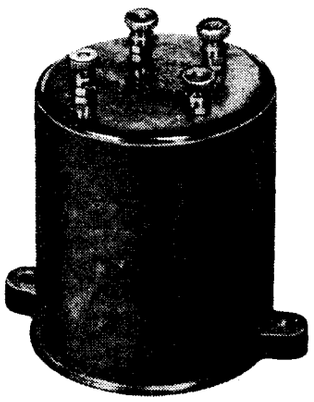
Ormond No. 7 three-gang condenser fitted with disc attachment.

The trimmers gave a variation of 71 micro-mfds., while the total capacity variation of the condenser, excluding that afforded by the trimmers, was 475 micro-mfds.

The makers are Ormond Engineering Co., Ltd., Ormond House, Rosebery Avenue, London, E.C.1, and the price is 21s. The slow motion dial showing in the illustration costs 2s. 6d.

SUPREMUS H.T. ECONOMISER

THE purpose of this device is to effect an economy of H.T. current in battery-operated sets, which it achieves by regulating the grid bias of the output valve according to the volume of sound emitted by the loud speaker. On weak passages, or when the volume control is turned down, the valve is biased back and less current is taken from the H.T. battery. Only when the last valve is working at full capacity



A unit that prolongs the life of the H.T. battery, the Supremus H.T. Economiser.

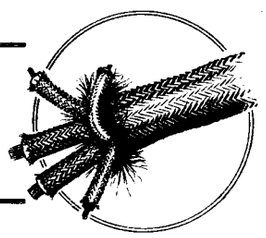
does the anode circuit rise to the normal value, consequently a considerable saving is effected and the life of the battery is prolonged.

With the unit connected to a receiver in which the last valve passed 10 mA. with normal grid bias it was possible to lower this to 2.5 mA. in the quiescent state by increasing the bias, and the only effect on the quality of reproduction was a slight harshness on very loud passages. With the quiescent current adjusted to about 5 mA. the quality was sensibly the same as with the normal working bias.

The unit is easy to install, as only one lead has to be altered and three extra connections made. The makers are Supremus Specialities, Ltd., 118, High Street, Erdington, Birmingham, and the price is 17s. 6d.

GOLTONE FIVE-WAY CABLE

WARD AND GOLDSTONE, LTD., Frederick Road (Pendleton), Manchester, 6, have developed a special five-way cable for use with modern receivers in which the power supply unit is separate from the receiver portion, and joined to it by a multiple cable. The L.T. leads may be required to carry up to six amps. in a superheterodyne, and to avoid voltage drop along the cable these two leads each consist of seventy strands of No. 36 S.W.G. wire.



Goltone new five-way cable with one pair of heavy leads for L.T. supply.

This is equivalent in area to a solid conductor of No. 16 S.W.G., and as the resistance is about 0.007 ohms per yard, even with six amperes flowing, the voltage loss in a cable of normal length is negligible.

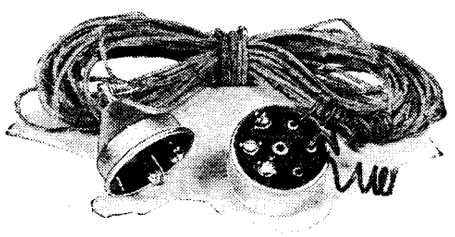
Heavy rubber insulation is used throughout, in addition to which each wire is covered with a different coloured cotton braid for identification. Both L.T. leads are, however, similar in colour.

In one style the remaining three wires are 23/36s., but a lighter cable having two 70/36s. and three 14/36s. is available also. The heavier cable costs 7d. and the lighter 6d. per yard for quantities over 100 yards. For short lengths 20 per cent. should be added to these prices.

RADIOFORMER STATIC FILTER SYSTEM

THE Radioformer static filter is a screened downlead aerial system developed for combating local interference, such as that radiated from fans, motors, flashing signs and other electrical devices. The shielded cable employed is of small diameter, and to offset the losses due to the capacity of the cable special impedance matching transformers are fitted at either end.

One transformer, housed in a conical-shaped metal container, is joined between the horizontal part of the aerial and the shielded cable, while the other matching unit is located close to the receiver. It en-



Radioformer screened downlead and impedance matching transformers.

tails very little alteration to an existing aerial, but to obtain the maximum screening effect it is necessary that the top, or horizontal span, be reasonably high and so outside the zone of the interference.

The actual losses are small, but as the system reduces interference to a far greater extent than the signal, the receiver can be operated at maximum sensitivity, which condition would not otherwise be possible. The makers are Radioformer, Ltd., York Works, Browning Street, London, S.E.17, and the price complete is 17s. 6d., including 50ft. of shielded cable.

CATALOGUES RECEIVED

The Gramophone Co., Ltd., 98-108, Clerkenwell Road, London, E.C.1.—A set of new catalogues and folders describing H.M.V. apparatus. In the series are included "Radio Receivers and Radio-Gramophones," "Radio-Gramophones for D.C.," "Superhet A.V.C. Portable Grand," "Superhet Radiogram Seven," "Superhet Selective Five," "Superhet Concert Seven with A.V.C.," "Superhet Autoradiogram Seven," "Superhet Ten Autoradiogram."

Electradix Radios, 218, Upper Thames Street, London, E.C.4.—Microphones for All: booklet describing microphones, microphone transformers, and allied apparatus.

J. H. Taylor and Co., Macaulay Street, Huddersfield.—Illustrated wireless guide, sets, components and accessories. 126 pages.

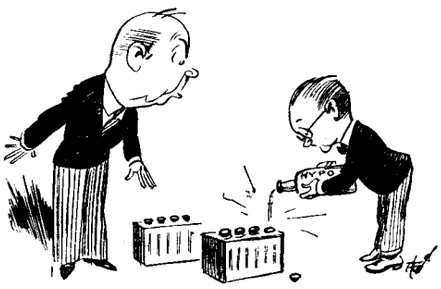
UNBIASED

By FREE GRID

A Moral Tale

PIOUS platitudes about the dangers of putting square pegs into round holes are frequently heard, but it is not often pointed out how, by the cussedness of nature, square pegs when stuck into square holes have a regrettable habit of becoming round, and vice versa. An instance of this was recently brought to my notice, and when I heard of it I could not refrain from making a mental note to pass it on to you in order to point out the moral, although what exactly the moral was, has for the moment escaped me.

The tale concerns an office boy who was employed by "W.W." some five years ago. He had long disturbed the editorial peace of mind by insisting on doing divers things beloved of office boys from time immemorial. The lad's chief



"The climax came . . ."

aim was, however, the taking of an unholy interest in photography and indulging in this unwholesome pastime at such times as he should have been devoting his time to the mysteries of push-pull.

The climax came when it was found that he had filled two new laboratory accumulators with hypo instead of their customary provender. The problem was eventually solved by his being sent with a strong letter of recommendation to the studios of a photographic artist.

But alas, for the frailties of human nature, as soon as he realised that he could spend all day and every day at his hobby, it palled on him and he sought a new outlet for his activities. To the astonishment of everybody this outlet took the form of radio, and soon the walls of the artist's studio were liberally besprinkled with circuit diagrams. The end of all things came when he attempted to develop an unrepeatable (and almost unprintable) work of art intended for the following year's issue of *Photograms of the Year* by immersing it in H_2SO_4.

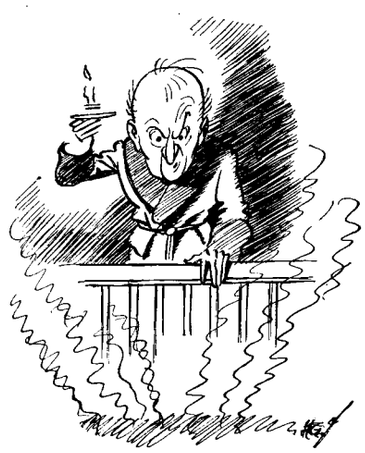
Photo-cells and Mice

A TREMENDOUS number of people are interested in my electrical mousetrap which I described the other week. I have received many enquiries from readers whose electrical supply is D.C. as, owing to their inability to step up the voltage, they are encountering special difficulties.

"I find," writes one correspondent, "that the 200 volts which I have available is more than ample to electrocute the mouse but trouble arises through the body being allowed to lie across the brass strips which I have substituted for meccano owing to it being cheaper. The resistance of the corpse is sufficiently low to permit a small current to flow through it and not only does this add unnecessarily to the electric light bill but, whether due to electrolysis or to the heating action, an objectionable smell of cooking arises during the night. Where have I gone wrong?"

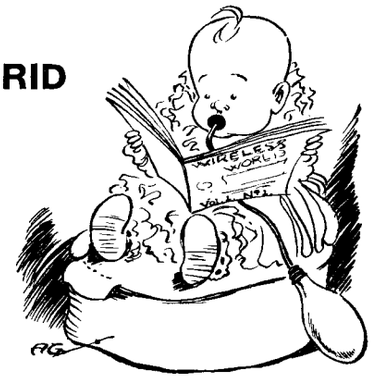
My correspondent has not, of course, gone wrong at all, and as I cannot advise the expense of a motor generator to raise his voltage I have to fall back on other means. I first thought of advising him to include in series with the trap a lamp which would light up dully when the current passed through the mouse's body. This could then be caused to shine on to a photo-electric cell which in its turn could operate a relay to switch off the current and so prevent the undesirable effects complained of. Unfortunately, however, this would mean that only one mouse would be caught per night, and so I had to think again.

I finally decided to advise him to attach one end of the trap to hinges and the other to a rope passing through a pulley affixed in the ceiling and thence down to a miniature capstan driven by an old fan motor. The motor would, of course, be switched on by the photocell and would duly tip the corpse into a suitable receptacle; the corpse's removal would, of course, switch out the lamp and restore the *status quo*.



Smell of cooking.

With regard to the many A.C. people who have asked me for the correct transformer ratio to use to bring about the simultaneous electrocution and cremation of rats, cats, stray dogs and unwanted relations, I am reluctantly compelled to say that I do not know.



Reader from the first number.

Radio and the Occult

ALL adherents of the *Wireless World* who have, to quote their own words, been readers from the first number—and believe me, their name is legion—will probably recollect the monotonous regularity with which the ha'penny Press used to "discover" wireless in those early days.

The gentlemen of the lay Press are rather noted for this sort of thing, but I really should have thought that the idea of getting a radio set, a gramophone, a film projector and a few other things and shoving them into one box to act as a sort of universal home entertainer was sufficiently ancient to be let alone. I myself, in fact, "invented" such a device in 1931 (*vide W.W.*, Oct. 28th), but I must confess that I took my inspiration from an instrument which was demonstrated to me by a friend in 1930 (*vide W.W.*, Dec. 31st).

It is quite evident, however, that the gentlemen associated with certain newspapers are of a different opinion, for I have just been reading of a remarkable account of yet another of these wonder machines which was recently demonstrated to a gaping crowd in a provincial town way up north.

It seems that the instrument is capable of measuring in sound the electrical energy of the human body. The subject stands in the light and the instrument produces different notes for the different frequencies of the subject. If he is of a nervous temperament it will make a high note, and if of a placid temperament a low note.

It is, I regret to say, impossible for me in the space at my disposal to mention all the occult powers which the newspaper, rightly or wrongly attributes to the inventor. After telling the newspaper man of certain mysterious happenings in India, including a prophetic vision of the wreck of the Hesperus, the inventor explained how this led him to think of the marvellous idea of building a radiogram-cum-home talkie outfit, which, apart from its normal functions, is apparently also capable of casting your horoscope and warning you when your mother-in-law's next visit is due.

Well, well, I suppose that, as Shakespeare says, "there's one born every minute."

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Progress

Opportunities and Problems

A *YEAR* ago we published a Progress Number of *The Wireless World*, in which we gave a survey of developments to that date. We then confined our attention to advances in connection with the design of receivers, in particular for broadcast purposes.

In the present issue, where we again attempt to provide an annual survey of progress, we have tried to broaden the scope of our survey to include reference to transmission possibilities and to touch upon television, whilst covering as well, progress in set design, valves, and other matters connected with reception.

It is impossible to discuss progress to date without venturing some forecast of future developments which seem likely in view of changing circumstances or technical advances, although the latter may at the moment be only in the laboratory stage.

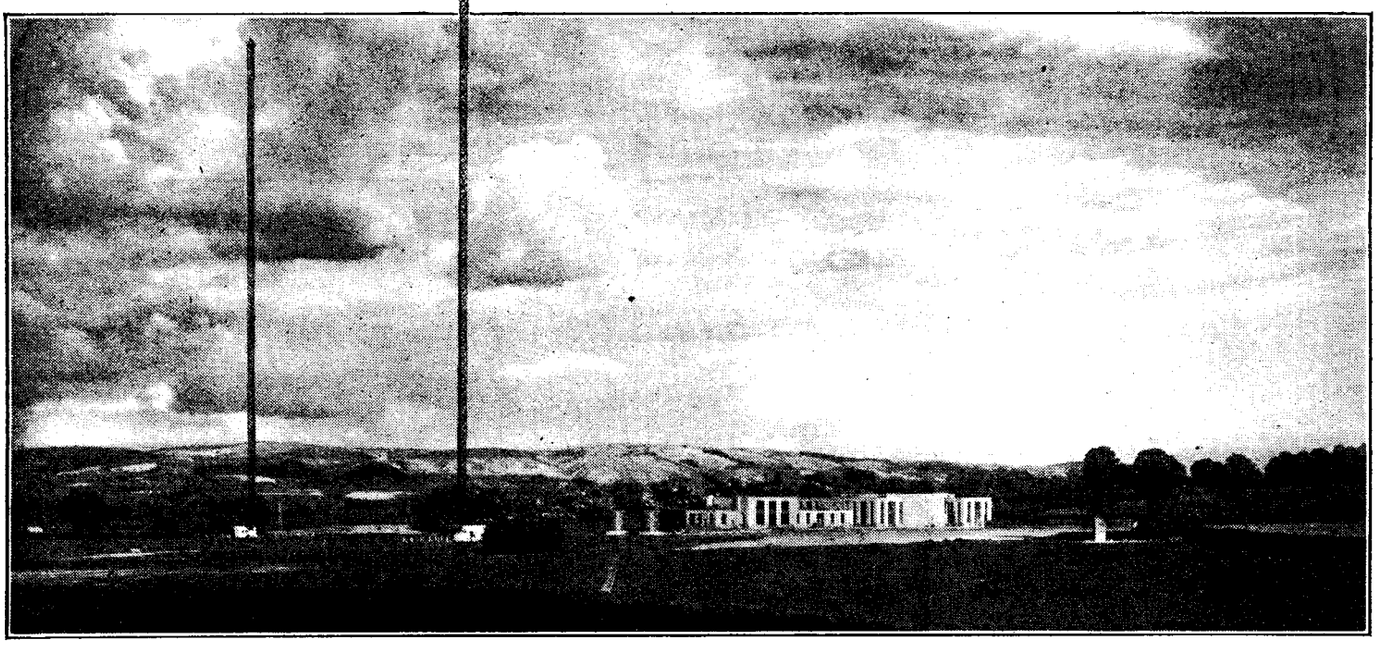
Progress Itself Produces New Problems

The opportunities for progress, particularly in the field of broadcast transmission and reception, seem to be increasing and there is no sign of finality even on the most distant horizon to-day, but although so much material is available, there are in many instances serious obstacles to be overcome before new developments can come into their own. If we take television alone as an example, we find that high definition pictures can be transmitted, and that in the laboratory, at any rate, really remarkable progress has been made. This progress in better definition has been dependent, however, upon the use of ultra-short waves of the order of seven metres for transmission. By the use of these wavelengths, our range from a given transmitter is restricted, and herein we foresee a great obstacle in the direction of distributing programmes. If we could content ourselves with television in one or two large towns, the problem would be simple, but to cover the whole country would necessitate a very large number of short-wave transmitters. Now, unless separate programme material is going to be put out from studios attached to every one of these transmitters, the problem to be faced in the matter of distribution from a very limited number of studios is serious, for line connections to link up all the transmitters would probably be prohibitive in cost, as well as an extremely difficult problem technically on account of the very wide frequency range required. It looks, in fact, as if every seven-metre television transmitter will have to be supplied with programmes by some wireless link also on a wavelength of the order of seven metres or less.

This is just one example put forward to indicate that, although great developments may take place in one branch of wireless engineering, the utilisation of such progress may be held up because of the complications arising in a different field where obstacles remain unsurmounted.

In the field of broadcast reception generally, whilst appreciating that great progress has been made, we feel that the time has come when there is serious risk of retrogression in the matter of quality of reproduction. In this respect we believe that the average receiver of to-day is not so good as some of its predecessors. Unless we exercise great caution we shall find the public becoming accustomed to accepting a standard of reproduction falling "progressively" short of the performance possible with the present stage of quality as put out by the transmitters.

Has Broadcast Transmission



The masts and buildings of the West Regional transmitters near Watchet, in Somerset.

The Problems of Broadcast Distribution

IN considering the tendency of broadcasting development during the course of the past year it is interesting to note how much the practice of listening to foreign stations has ceased to be an activity of questionable usefulness and become an accepted fact. It is not so long ago that these matters were the subject of keen debate in the lay and technical Press, and the continuous advocacy of "distant listening" in the Editorial columns of the *Wireless World* has proved itself amply justified by the facts.

The main factor governing the situation has been the increase in the power of all broadcasting stations. This has had the effect that, whereas most foreign stations were so weak in comparison with atmospheric and "man-made" disturbances as to provide no entertainment of any value, now many stations are clearly audible above the level of general interference, and the only problem confronting the listener is how to select any one from the mass.

The tendency of broadcast transmitting developments has thus put a premium upon the design of selective receivers, in which the embodiment of automatic volume control devices has made the reception of distant stations even more satisfactory by keeping the strength of the reproduction at more or less uniform level in spite of the inevitable "fading" associated at times with long-range reception. Taking into account the activities of *The Wireless World*, the Post Office, and other organisations in mitigating the nuisance of electrical interference, it would almost appear that enough had been done in the direction of increasing the power of broadcasting stations and that in this sense it was permissible, and even desirable, to call a halt.

The less favourable aspect of present-day broadcasting transmission is, of course, the chaos surrounding the distribution of wavelengths. The problem is perhaps more political than technical, though it is even pertinent to ask whether, were it not for questions of prestige and similar stupidities inseparable from the field of international politics, it would not be possible to arrive at an allocation of wavelengths amply satisfying the reasonable requirements of the nations. In a situation of this sort we can only pray that, politically speaking, finality has not been reached, and, in the meantime, a review of the situation from the engineering standpoint may not be out of place.

Types of Interference

The nature of the interference between two wireless stations has been analysed under three heads: first, "heterodyne interference," which is the continuous whistling note heard when the carrier frequencies between two neighbouring transmitters differ by an audible frequency; secondly, programme interference, which is the breaking through, during reception of a wanted station, of the actual subject matter transmitted by an interfering station; lastly, "side-band interference," which may for the moment be considered as the breaking through, during reception of a wanted station, of unintelligible sounds resulting from the transmission of an interfering station.

Of these various forms of interference, the first can be mitigated in practice by suppressor devices in the receiver with very little detriment to reception, and the second is, at any rate in theory, capable of complete elimination by satisfactory receiver design. The last is a type of interference which is inherently part of the wavelength distribution, and in the writer's view has the most destructive effect in practice, using a good average up-to-date receiver. The result of side-band interference is familiar to all broadcast listeners as a kind of chirp or "grasshopper noise," the tone of which is such as to fall within the range of frequencies necessary for good reception. As a consequence, any attempt to increase the selectivity of a receiver so as to cut out these noises also results in the cutting out of desired components of the wanted transmission, and thus in a loss of quality.

The only radical improvement which can be effected in this situation is by the adoption of what is known as "single side-band transmission." Normal radio transmission is carried out by causing the strength of the waves radiated from the aerial to be varied in rhythm with the audio-frequency vibrations corresponding to the transmitted subject matter. Such rhythmic variation or modulation has the effect of sending out a band of waves from the transmitter instead of the single "carrier-wave" which is characteristic of the modulated state. These so-called "side-

Reached Finality ?

ALTHOUGH the real problems of broadcast distribution in Europe are at the moment political ones, technical developments such as the author discusses in this article may materially assist in bringing about an improvement in the present ether congestion

By P. W. WILLANS, M.A., M.I.E.E.

bands" exist in pairs, one below and one above the carrier wave, and on technical grounds it is fairly easy to show that only one of these pairs is necessary to transmit the desired subject matter, though ordinary methods of modulation produce both together.

Is "Single Side-band" a Solution ?

If two transmitting stations are operating on adjacent frequencies it is clear that the upper side-band of the station having the lower frequency tends to mix itself with the lower side-band of the station having the upper frequency, and the result is the type of interference which has last been dealt with. If, then, it were possible to transmit only one set of side-bands, say, the lower of each station, there would be no mixing of side-bands and an increase in the selectivity of the receiver would enable complete separation to be effected.

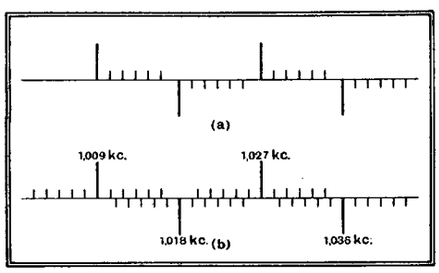


Diagram illustrating side-band interference and its avoidance by single side-band operation.

In the accompanying diagram the lower figure illustrates double side-band transmission, and the upper figure single side-band transmission on carrier waves of 1,009, 1,018, 1,027, 1,036 kilocycles respectively, the modulation consisting of a note of fundamental frequency of 1,400 c.p.s. and its harmonics up to the fifth. The lines indicate the frequencies which are transmitted (carriers represented by long lines).

It is obvious from the lower figure that if this note is to be received from any station with its quality unimpaired, other frequencies will be received due to the heterodyning of the neighbouring side bands with the carrier of the station being received. The actual "parasitic frequencies" in the case illustrated will be 2,000, 3,400, 4,800, 6,200, and 7,600 c.p.s.

There would thus be a prospect of removing the whole trouble of side-band interference if the present separation of stations were to be maintained, but for one practical limitation, namely, the fact that, while normal types of receivers will receive single side-band transmission intelligibly, there will be a distortion not present in the case of transmission of the normal type. This distortion increases the greater the degree of modulation of the transmitter, and constitutes a serious obstacle to the general adoption of such a system, as no change in transmission would be contemplated which rendered large numbers of receivers obsolete or even impaired their efficiency.

Single side-band transmission has so far been mainly applied to commercial telephony, more particularly to so-called "wired wireless" systems. Here it is the practice to remove the carrier wave as well as one set of side-bands, and it is then necessary to replace the carrier wave at the receiving end. Without the use of an oscillation generator at the receiver it is not possible to receive the original signals, and if means of this type for supplying the missing carrier are available the results will be seriously distorted if the carrier wave is to the smallest degree mistuned to its correct value. It is stated that the mistuning of one cycle per second is detrimental to the good reception of music, the result being that the instruments play out of tune. Even if it were possible to ensure that a local oscillator retained its correct frequency to the required degree of exactness, it does not seem likely that the average listener would be capable of tuning his set in closely enough to take advantage of the possibilities offered by this system. If it were practicable to work on these lines, all that would be necessary would be the addition of such a local oscillator to existing receivers, and the results could be made free of the distortion previously referred to by the injection of a local oscillation of sufficient amplitude.

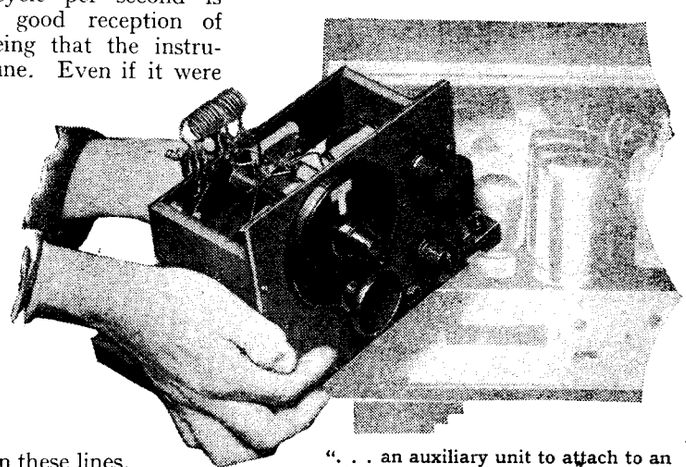
Assuming that such an arrangement is impossible in practice, either the carrier wave must be transmitted in such a large measure as to reduce distortion to very low limits, or else special circuits must be devised for rendering the reception free of the distortion above mentioned. The latter alternative seems to mean the obsolescence of existing receivers, and the former the reduction of the depth of modulation to a degree probably much less than that of present-day transmission, and such as to interfere with efficiency. New developments may, of course, overcome the difficulty.

It is to be hoped that investigation into the problem of single side-band transmission will result in some statement which will clear up the possibilities of operation along these lines. Assuming that the perfect engineering solution is obtained, there still remain the difficulties involved in securing its adoption by other countries, since the various nationals will lose by the suppression of half of their own side-bands, and will only gain by the suppression of those of their neighbours. Should the alteration be put into practice, the additional problem will remain of preventing a kind of Malthusian process from taking effect, the number of transmitting stations increasing and multiplying up to a level where results would be as intolerable as they are at present. The prospect does not appear very bright, but the problem is outside the range of technical discussion.

Other Wavelengths

Mention must here be made of the possibilities of broadcasting on other wavelengths, as it seems that circumstances may necessitate some radical change, if relief is not forthcoming to the present state of chaos either by political action or technical development.

As is well known, if we pass down the scale of wavelengths below 200 metres, the waves become progressively less suitable for broadcasting, or, in fact, for any other form of wireless communication, owing to the fact that they are severely attenuated in passing over the ground, and imperfectly and irregularly reflected by the upper atmosphere. This state of affairs prevails until we reach a wavelength somewhere below 100 metres,



". . . an auxiliary unit to attach to an existing radio receiver . . ." The ultra-short-wave adaptor.

Has Broadcast Transmission Reached Finality?—where the condition of the upper atmosphere begins again to be favourable for general radio communication, but not particularly for broadcasting, since results are irregular at short distances from the transmitter and do not settle down until considerably greater distances have been reached. There is, moreover, the fact that these wavelengths have been largely appropriated for commercial traffic, and the allocation of any of them for the purpose of broadcasting might involve us in difficulties of the kind we are trying to avoid.

It is not until we reach wavelengths of ten metres and below that other possibilities begin to open up, owing to the fact that reflection from the Heaviside layer definitely ceases. It is true that the attenuation of the ground waves is high, so that the range of operation of an "ultra-short-wave" station is strictly limited, but, then, so also is the range where one station might interfere with another, so much so, in fact, that wavelengths might be indefinitely duplicated, provided transmitters were situated some 50 to 100 miles from each other.

The problem of serving one area such as England with good-quality broadcast transmission is admittedly complicated and perhaps impracticable, but the potentialities cannot be ignored, since they comprise complete immunity from interference troubles of the kind which have been described, better acoustic fidelity than is at present possible, and the ability to transmit multiple programmes as the modulations of a single ultra-short-wave. All that is required for the reception of such wavelengths is an auxiliary unit to attach to an existing radio receiver so that present apparatus is not rendered unserviceable, but, of course, an existing aerial will not be suitable, and perhaps very elaborate aerial arrangements may be required.

It is quite impossible to speak with certainty of the possibilities of ultra-short-wave broadcasting until more practical information is available as to the behaviour of these waves, of which very little is known at present. All that we can say is that they more closely resemble light and heat waves in that they do not readily pass through buildings and so forth, and do not bend round obstacles to the same extent as the longer waves. The strength of signal which a householder might pick up on his aerial is thus capricious in the extreme, and may vary enormously from street to street, and even house to house.

DISTANT RECEPTION NOTES

A New Spanish Custom : Wavelength Wobbling

THERE has been a good deal of wavelength wobbling of late, mostly on the part of the smaller fry. Amongst the worst offenders are the Spanish stations, very few of which are working exactly on their proper wavelengths. There is also that old nuisance Radio LL, a French privately-owned station, which ought to work on 360.6 metres, sharing the wavelength with Moscow IV. Actually it has been working about two metres too high and has thus severely heterodyned Bucharest. Let us hope that the present French Government will remain in office long enough to tackle seriously the problem of its outlaw stations as well as that of the Eiffel Tower.

The Spanish stations present a rather different problem. None of them, so far as I can ascertain, is controlled by crystal or tuning-fork. On the whole they are probably doing their best to keep to their allotted wavelengths, but something rather better than this is required if they are not to find themselves classified as international nuisances.

A Birmingham reader tells me that he receives Heilsberg clearly and well, though I have not so far been able to find this station clear of interference. It is inconceivable that there should be a piercing heterodyne at one receiving station and none at all at a second only some seventy miles away. One of us, therefore, must be wrong in his identification of the station. I cannot claim to have heard the call-sign of Heilsberg—the heterodyne is too bad for that; but I have in more peaceful intervals heard German spoken, and as my set is very carefully calibrated I don't think that I am in error in identification. Perhaps some reader will be able to help. There is, of course, always the possibility that my Birmingham correspondent and I listen to Heilsberg at different times, and that he chooses a period when Heilsberg is free from whistles. Another reader kindly points out that the station using the wavelength of 240.2 metres assigned to Luxembourg is Juan-les-Pins. Some weeks ago I mentioned a rumour that Luxembourg had reformed and was working on the medium waves. This arose through the use of both English and French by the announcer of Juan-les-Pins.

Though the long-wave position is still pretty bad, the Lucerne Plan is undoubtedly working well on the medium waves. No real improvement can be expected on the long-wave band unless the Geneva conference arrives at some satisfactory agreement. Room must, I think, be made for Luxembourg by hook or by crook, for this station has shown that it intends to maintain its position by sheer weight of kilowatts, and when there are two hundred of them available, kilowatts, like money, talk.

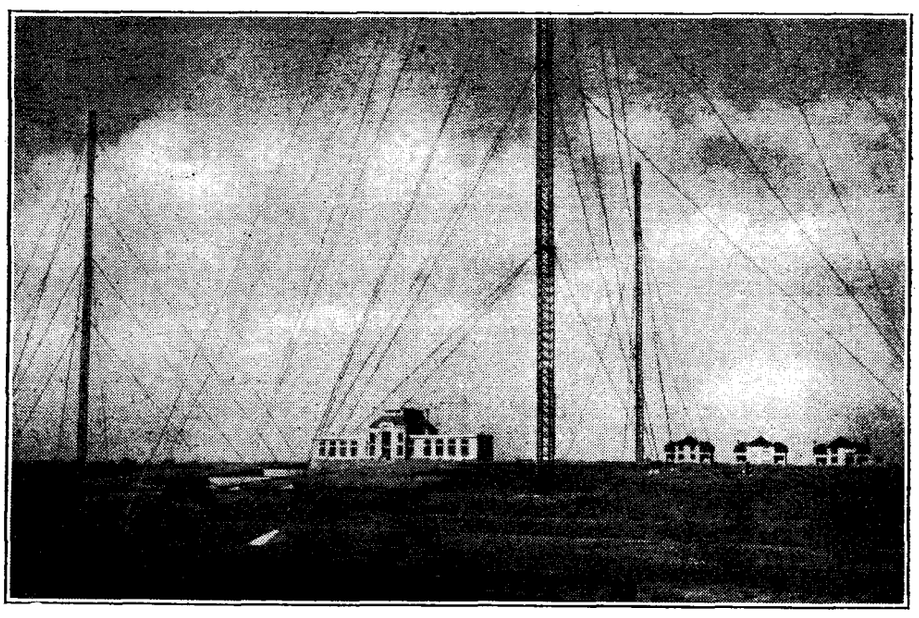
On several recent evenings I have heard what I believe to be experimental transmissions from the new Belgrade transmitter on 437.3 metres. Except when one is using a very sensitive set, the 2.5-kilowatt transmitter seldom rises above bare audibility. But on certain recent evenings loud speaker reception has been obtainable with a volume that suggests many more kilowatts.

The best part of the medium waveband is undoubtedly that between 300 and 549.5 metres. Here, with the exception of Leipzig and Berlin, every important station is well and clearly heard on most evenings. The best are Budapest, Beromünster, Stuttgart, Vienna, Florence, Brussels No. 1, Lyons, Langenberg, Söttens, Paris PTT, Stockholm, Rome, Munich, Milan, Hamburg, Brussels No. 2, and Breslau.

Below 300 metres there are comparatively few stations which can be regarded as certainties, though Bordeaux, Frankfurt, Trieste, and Juan-les-Pins come in well more often than not. Wavelength wobbling is responsible for most of the trouble below 300 metres. D. EXER.

The Practical Electrician's Pocket Book, 1934.—Edited by F. H. Robinson. 36th Annual Edition, comprising eight sections:—Principles and Laws of Electricity, Generation, Transmission and Distribution, Wiring Theory and Installation, Electricity in Industry and Commerce, Domestic Uses, Communication and Transport, Supply Voltages in the United Kingdom. This last section will be of great service alike to users of mains-driven sets, manufacturers and retailers. An interesting innovation is that undertakings with time-controlled (synchronised) frequencies are specially indicated. The book begins with a summary of the Technical Developments during 1933.

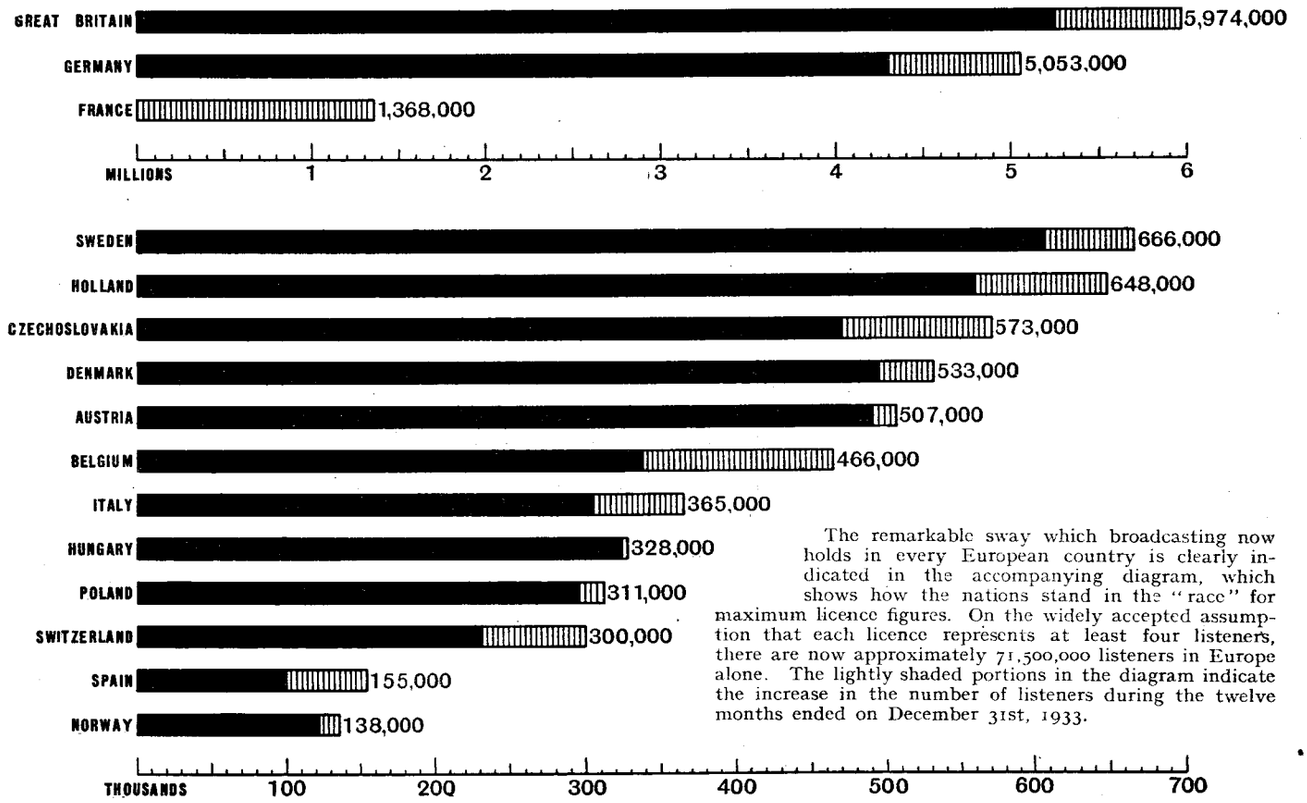
Pp. 592 + xlviii. Published by Electrical Trading and Electricity, 29, Bedford Street, Strand, London, W.C.2. Price 2s. 6d.



STICKING TO ITS GUNS. The Luxembourg 200-kilowatt broadcasting station, which, by retaining its long wavelength has been the largest contributor to the failure of the Lucerne Plan on the long waveband.

HOW BROADCASTING STANDS TO-DAY

New Official Licence Figures : European Audience Exceeds 70 Millions

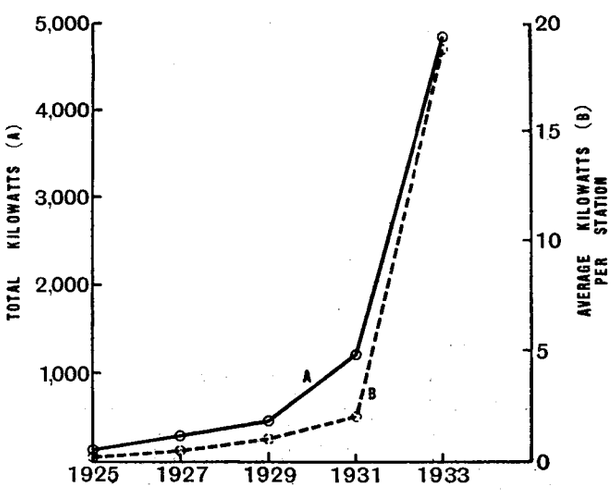


The remarkable sway which broadcasting now holds in every European country is clearly indicated in the accompanying diagram, which shows how the nations stand in the "race" for maximum licence figures. On the widely accepted assumption that each licence represents at least four listeners, there are now approximately 71,500,000 listeners in Europe alone. The lightly shaded portions in the diagram indicate the increase in the number of listeners during the twelve months ended on December 31st, 1933.

Other European countries not included in the diagram account for approximately half a million registered listeners. In the case of France the licence system did not exist prior to last year, and a very considerable increase in the number of listeners may be expected within the next twelve months. The record percentage gain in a year was achieved by Palestine, with a 155.5 per cent. increase, bringing the total to 2,500. The lowest recorded licence figure is that of Levant, viz., 785. Italy's comparatively low figure is ascribed to "piracy" and also to the climate, the portable set makers not having "cashed in" on the national love of open-air life.

PROGRESS IN POWER

Showing how the total kilowattage of European stations has increased in eight years.



WHAT LISTENERS PAY

A comparative table of licence fees.

	s.	d.
Russia (multi-valve sets)	56	6
Esthonia (multi-valve sets)	43	9
Germany	36	9
Yugoslavia	31	9
Hungary	29	4
Italy	25	6
Poland	25	4
Latvia	24	6
Rumania (multi-valve sets)	21	9
Bulgaria (multi-valve sets)	21	6
Czechoslovakia	21	2
Austria	20	9
Norway	19	10
Bulgaria (crystal and one-valve sets)	12	11
France (valve sets)	11	9
Rumania (crystal sets)	10	11
Sweden	10	2
Belgium (valve sets)	10	1½
Great Britain	10	0
Esthonia (crystal sets)	9	9
Denmark	8	10
Finland	8	9
Russia (crystal sets)	7	1
Lithuania (valve sets)	5	10
France (crystal sets)	3	7
Belgium (crystal sets)	3	5
Lithuania (crystal sets)	1	2

Holland. No tax. Voluntary contributions.

Spain. No tax. Sponsored programmes and voluntary contributions.

PROGRESS and the RECEIVER

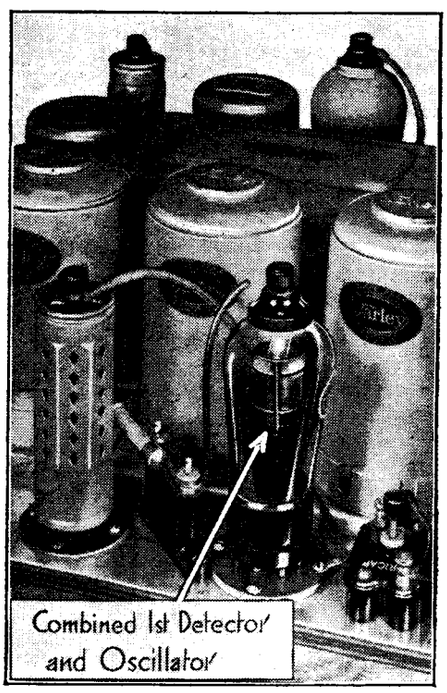
Development During the Year

RECENT trends in receiver design have been influenced very greatly by valve development, and comparatively little progress has been made during the past year in circuit improvement alone. The major developments, such as A.V.C. and the small superheterodyne, are very largely the result of improved valves. In this article the modern tendencies in design are discussed.

By W. T. COCKING

THE story of recent development in receivers is very largely that of progress in valve design. The past year has seen very little advance in pure receiver technique, and development has lain almost entirely in the applications of new valves to give an improvement in performance. This does not necessarily mean that the year has been unfruitful; on the contrary, definite advances have been made. These advances, however, lie more in the field of valve design than in the receiver.

This is no new thing in the history of radio, and it is remarkable how progress in the past has taken place alternately in the two fields rather than continuously in each. In earlier days, receiver design resulted in the neutralised H.F. amplifier. Valve development then produced the screen-grid valve and made the Neutrodyne unnecessary. A circuit development, the superheterodyne, came again to the fore and paved the way for the use of highly selective circuits with tone-correction for sideband cutting.



The modern superheterodyne is usually fitted with a single valve frequency-changer. In this set a Heptode is used.

Following this, a deluge of new valves appeared, with the result that interest concentrated on their application, to the detriment of circuit development.

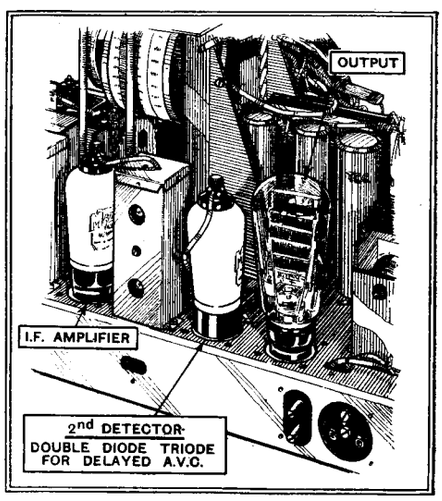
Nothing striking, therefore, has appeared in the past year in the way of changes in circuits as distinct from changes which are inevitable consequences of the use of new types of valve. To the casual observer, the growth of the superheterodyne would appear to be the greatest development, but this is actually only a continuation of a trend which was well under way the previous year, and which was even then rapidly displacing the straight set.

The Frequency-changer

Receivers, therefore, follow very much the same lines as in the preceding year, but the performance has usually been improved through the use of new types of valves. H.F. pentodes are replacing the screen-grid tetrode for H.F. and I.F. amplification purposes, and are likely to lead to some improvement in reproduction since their characteristics are more nearly linear. In the frequency-changer of the superheterodyne it is common to find a valve of this type employed as a combined detector-oscillator, although this is a trend which will probably soon be abandoned in favour of single-valve arrangements embodying the Heptode or the triode-pentode.

For a long time the anode-bend detector has not been in favour with receiver designers for demodulation purposes, but the *coup de grâce* has been administered this year by the introduction of the multiple-diode class of valve, which has also largely superseded the power grid detector. The increased linearity of detection has resulted in a reduction of distortion, but the chief reason for its use lies in the fact that it is the most convenient form of detection when automatic volume control is fitted.

In A.V.C. we have, perhaps, the chief modern trend. A year ago receivers so equipped were in a minority, a year hence they will probably be in a majority. The favourite method of obtaining A.V.C. in a commercially designed set is with the aid of a duo-diode-triode valve which is so connected that one diode provides signal rectification, the other delayed A.V.C., and the triode acts as a simple L.F. amplifier. The chief merit of the system is its simplicity, and it can certainly provide effective A.V.C. over a limited range of signal inputs. Some form of "local-distance" switch is necessary in most cases, however, to prevent overloading when listening to a local station.



Automatic volume control is most commonly obtained with the aid of a duo-diode-triode valve.

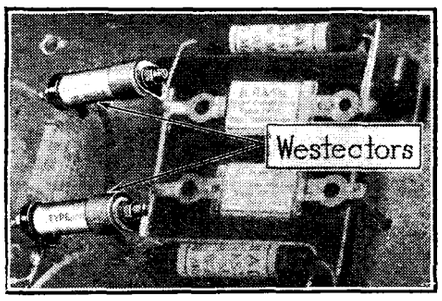
Other forms of A.V.C. include a similar circuit embodying Westectors instead of a valve, and this proves most popular in battery sets owing to the increased economy in current consumption, although it is often to be found in mains driven apparatus. Delayed amplified A.V.C. in its various forms is capable of improved control, but is less used on account of the increased complication and the greater cost.

In order to avoid the excessive background hiss which often results when an A.V.C. set is mis-tuned from a station, some form of noise suppressor is usually fitted. This most commonly takes the form of an arrangement whereby the maximum sensitivity of the set can be reduced by the operation of a switch while tuning is carried out. A scheme of this nature is very effective and inexpensive; it is, however, open to the drawback that the operator often forgets to move the switch before retuning the set. Automatic methods, therefore, usually known as Q.A.V.C., are slowly coming into favour, but since they necessitate an

Progress and the Receiver

additional valve it will probably be some time before they find their way into the inexpensive range.

There are two general types of Q.A.V.C. system; in one an additional valve is provided and arranged so that the grid bias of an L.F. amplifier is dependent upon its anode current. In the absence of a signal, the valve passes a high current, and a large bias is applied to the L.F. valve and completely blocks this stage. On tuning in a station, the bias is automatically removed, and the stage functions normally. Obviously, critical adjustment of the circuit constants is required if the scheme is to work correctly and not introduce distortion. The alternative arrangement operates with the aid of a mechanical relay, the contacts of which are arranged to short-circuit the input to the L.F. amplifier in the absence of a signal. It is possible to obtain good action without an additional valve provided that a sensitive relay be used, for it may be operated by the change in anode current of one of the valves controlled by the A.V.C. system. In general, however, more reliable operation is secured by using an additional valve to control the relay, and also a more robust relay can be employed.



In many sets Westectors are used for the detector and for the A.V.C. rectifier.

Battery Output Stages

Little change has taken place in regard to L.F. amplification save to reduce it in amount. The pentode holds pride of place for the output stage of commercially built receivers on account of the considerable output which it gives for a moderate signal input. The only criticism which can be directed against this widespread use of the pentode is in regard to quality of reproduction. Although many claim that the pentode is as capable of giving high quality as the triode, there is no doubt that it requires much more careful design of its circuits and more expensive output equipment. If it be designed for high quality, therefore, the pentode output stage loses most of its attractiveness, and we find that where large output and high quality are considered important the triode output valve still holds undisputed sway.

The most striking advances of the past year have taken place in the battery receiver, and have also been chiefly due to valve design. The H.F. pentode, duo-diode-triode, and Heptode have all made their appearance, but it is the output stage which is pre-eminently important. As long as the output is undistorted, the ordinary output stage consumes the same current from the H.T. supply whatever its signal input. The fundamental difference of the various new output stages lies in the dependence of their anode current upon the input. During an interval in the programme the anode current is very low, and it is still small during a quiet passage of music, only reaching the figure associated with an ordinary output stage during the loudest passages. Thus there is a considerable saving in the average current drain on the H.T. battery. There are two main systems of obtaining this economical operation—the Class "B" and the Q.P.P. arrangements. Of these two, the former has been the more popular during the past year, but there are now signs of a revival of interest in quiescent push-pull. A circuit, as distinct from a valve development, which permits economical working is worthy of mention. In this arrangement, an ordinary pentode output valve is used, but it is biased nearly to the current cut-off point so that the drain on the battery is small. A Westector is then connected to the anode circuit in such a way that the grid bias is reduced as the signal input increases.

Selectivity

Apart from major developments of this nature, the trend in design has been largely in detail improvements in circuits and components. Such improvements are highly important, but they are not spectacular. The congested state of the modern ether has caused a demand for high selectivity, and this has led to improvements in the efficiency of tuned circuits and been largely responsible for the popularity of the superheterodyne. Valve development has made it possible to reduce the number of stages embodied, so that four-valve superheterodynes are now common, and three-valve models are beginning to make their appearance. There is, therefore, a definite trend towards reducing the number of valves employed in a receiver, but it is one which can easily be carried too far with detrimental results to quality of reproduction.

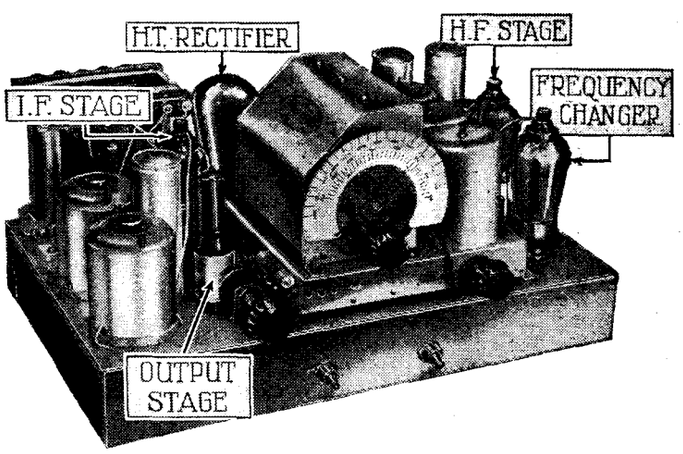
So far as adjacent channel selectivity is concerned, it is safe to say that it cannot be further increased without seriously affecting the quality of reproduction, and if tone correction were introduced to offset this, the resulting decrease in interference would be quite small in most cases. This cannot be said of second channel selectivity, however, for here there is room for improvement in most sets. The sensitivity of all but the smallest receivers is now adequate for good distant reception, often with only a few feet of wire for an aerial. The limit for distant reception, in fact, is now set more by the prevalence of interference, atmospherics, and man-made static than by any lack of sensitivity in the receiver.

Future Development

So much for the past, what of the future? There seems to be no doubt that in one form or another the superheterodyne has come to stay. In its future form it will undoubtedly split into two classes of which one will be the large and expensive type of set and the other the three- and four-valve "popular" receiver. All sets are likely to include A.V.C., and many will have quiet automatic volume control.

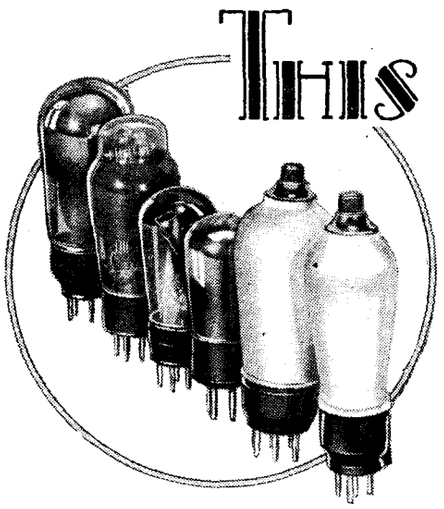
If the trend in the past is any guide to that of the future, it is clear that the coming year should be one of circuit development as distinct from valve design. For a year past new valves have been pouring forth from the factories, it is surely now time that the flow ceased for a space. Circuit development is overdue in the cycle of events.

During recent months, commercially built sets and home constructed receivers have followed similar lines both as regards mechanical construction and circuit design. This has been an inevitable consequence of the lull in circuit development. At a time when advances are made chiefly in circuit design, the home constructed set is likely to be more up to date than a factory built receiver because new technique can be more quickly applied to it, but this does not apply to the same degree when development occurs chiefly in valves. If the omens are correct, therefore, and we are looking forward to an era of advances in circuits, the coming year is likely to see greater developments in receivers for home construction than in factory-built sets.



A typical modern four-valve superheterodyne with a Heptode frequency-changer and A.V.C. obtained with the aid of Westectors.

This Year of Valves



VALVE development during the past year has been largely concerned with the production of multiple types, but existing classes have also been improved. As a result, the number of new valves which has appeared is perhaps greater than in any preceding year. In this article the functions of the chief specimens of the new types are discussed.

By M. G. SCROGGIE. B.Sc., A.M.I.E.E.

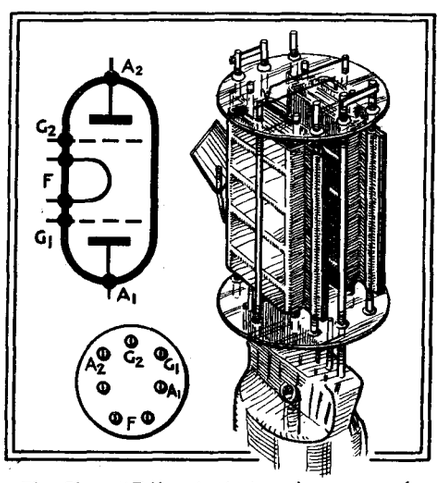
THE story of modern receiver design is predominantly the story of valve design; a fact which gives importance and interest to the statement that no single year has seen so much new valve development as the last. So much has happened, in fact, that it is quite difficult to realise that when the last Progress Number was written the Class "B" valve even was not actually in the field, but only heralded. It was the first of a flood of new valves pouring into every socket on the receiver (and. incidentally, finding that most of the sockets did not fit, owing to excess of pins). It is, therefore, instructive to review the deluge and try to assess the benefit thereof, and to decide whether any of it is of negative or doubtful value.

Three lines of development can be traced:—(1) evolution of new classes, (2) combinations of classes within one envelope, and (3) improvements of existing classes. A "class" of valve is to be taken as a broad subdivision; for example, H.F. pentode or double-diode-triode. Within these classes are many different types, denoted by a mixture of numbers and letters at the whim of the maker.

Class "B" Improvements

The remarkable feature of the year's progress has been the tremendous output under the first heading. Although the Class "B" valve was mentioned a year ago its arrival comes within the present period, and it was the first of a whole series of developments. It may surprise some to know that the Class "B" valve is just a modern revival of the ordinary valve of 1915, to overcome the defects of which the push-pull system of connections was devised. The early valves passed very little anode current at zero grid voltage, and amplification was effective only when the grids were driven positive—hence the idea of combining a pair of valves to make good the missing negative half-waves. The theory and practice of Class "B" amplification has been too thoroughly dealt with in these pages to need repetition now; the only comment on progress in this direction is to point out what might be described as semi-Class "B," for which the valves are designed to work with a small negative bias. Spurious oscillation and other causes of distortion, towards which the earlier Class "B" valves had a regrettable leaning, are thus minimised.

Although the prime demand for Class "B" is as an H.T. battery economiser, and its use in ordinary mains-driven sets



The Class "B" output stage is now nearly universal in battery receivers, and the electrode assembly of a typical specimen is shown here.

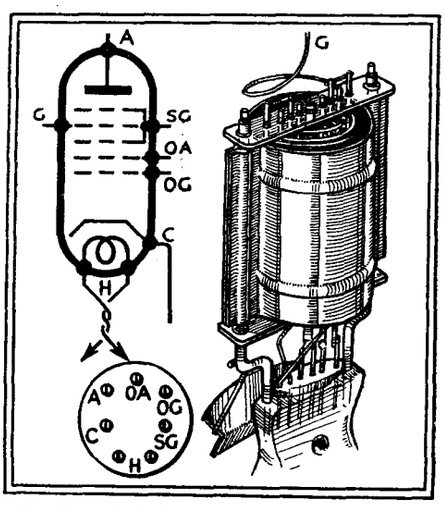
seems to be completely futile (seeing that the power saved by the valve has to be wasted somewhere in the source), special types are available for very high power work, having an output of more than 20 watts per pair.

At the other end of the set is a very important and valuable new class—the heptode or pentagrid frequency-changer, for superhets. Ever since the superhet. was invented designers have grudged the power and space used by a separate oscillator valve, and even ten years ago it was customary to attempt to combine the oscillator and first detector in one valve. These attempts have gradually become more and more successful as valve and circuit design proceeded; and last season the majority of superhets. made use of a tetrode or pentode with cathode injection, which although satisfactory on the whole was still short of the ideal. It looks as if the heptode or triode-pentode will supersede all other types of frequency-changer during the coming season as, so far from being a compromise, it appears to be a definite improvement over the separate oscillator valve, apart altogether from reducing the total number of valves by one.

The screened pentode is the direct successor to the ordinary S.G. tetrode, and seems likely to take its place entirely. Both short-base and variable-mu types are made; the former has already been given notice to quit the frequency-changer socket, and its occasional occupation of the second detector position also seems untenable in the face of other developments of which more will be said in a minute or two. So the variable-mu pentode will probably be one of the most important and popular classes next season. It serves the same purpose as its forerunning tetrode types, but owing to the suppression of the "dynatron dip" which rendered a large part of the tetrode characteristics unavailable for amplification, it is capable of a greater undistorted output. Given good tuning circuits it can also give a bigger stage gain than any previous types, and the screen voltage arrangements are less critical.

Multiple Valves

Coming now to the second division of our review, we find a strong tendency at work to combine valves in one bottle. As a principle this is not altogether praiseworthy, though perhaps some of the com-

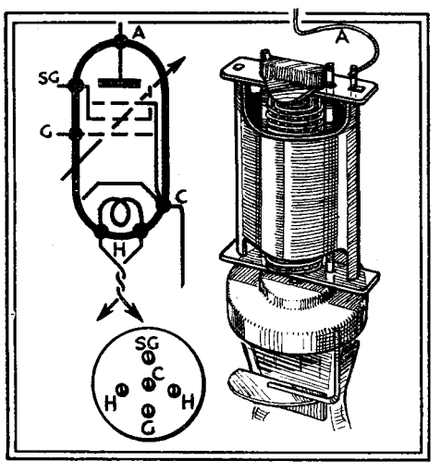


The Heptode bids fair to supersede other one- and two-valve frequency-changers in future superheterodynes.

This Year of Valves—

binations that have been evolved may be justified. The number of single valve types is already absurdly excessive; what might happen if the makers were to give free rein to their ingenuity in evolving combinations of them is too terrible to think about. Theoretically, there are countless billions of combinations of only ten types. Another obvious disadvantage of the multiple valve is that if a fault develops in one section the whole valve must be renewed. And the matter of valve sockets is a difficult one, too.

Two diodes are nearly always included in any diode combination, because so very much more can be done with two than with one; and although duo-diode valves (other than for power rectification) are marketed, they have never gained much of a hold, for the combinations of them with triodes, tetrodes and pentodes appeared almost as soon, and seem definitely to be justified. For one thing, the diodes themselves are very tiny, and appear hardly worth while making up into a separate valve. They do not require a separate cathode in the combination,

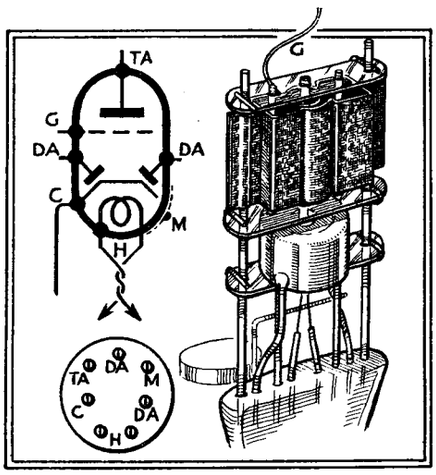


The H.F. and I.F. amplifiers of the modern receiver include variable-mu H.F. pentodes in preference to tetrodes on account of the greater linearity of characteristic.

and owing to this and to their inherent simplicity there is very little added risk of failure due to their inclusion. But, of course, we do not want to see every valve in the catalogue duplicated in order to provide diode combinations throughout. There seems to be good reason to suppose that a pair of diodes combined with a high-sensitivity output pentode will supply the whole of the detector and L.F. valve requirements in most of the future receivers. Designers who prefer the greater flexibility of independent diode rectifiers can always use metal rectifiers ("Westectors") for the purpose.

Diode and Amplifier Combined

In the meantime, the most popular valve in this class is the duo-diode-triode; the triode portion having characteristics that have been the favourite ones ever since separately heated valves appeared—an A.C. resistance of 10,000-15,000 ohms and a slope of about 3.5 mA. per volt. This is almost a standard. Similar characteristics have also appeared



The duo-diode-triode is becoming widely used as a combined detector and first stage L.F. amplifier since it can also provide A.V.C.

in battery valves; and with the development of short grid-base variable-mu battery valves we now have all that is needed for automatic volume control—hitherto exclusive to mains-drive.

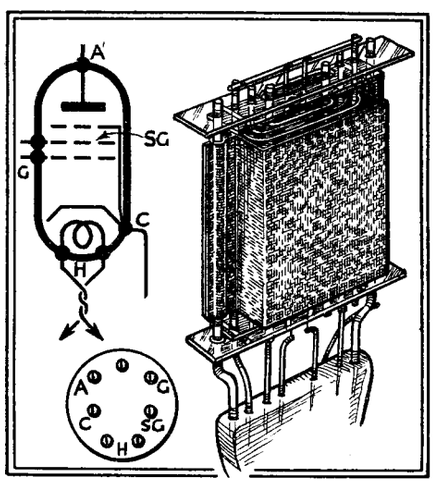
Another combination valve has already been dealt with under the first heading—the Class "B" valve. It can be—and sometimes is—supplied as a single valve. The reason for combining a pair is that one valve by itself is useless, so the only advantage of supplying them separately is that premature failure of one does not necessitate both being replaced. On the other hand, a combined pair costs less than a separate pair. But the main point is that the sale of a combined pair implies that the manufacturer considers the two halves to be sufficiently well matched to work together, whereas one might not be justified in making such an assumption with regard to two separate samples taken at random.

The same argument applies to a more recent type of multiple valve, the double Q.P.P. pentode. It must be admitted that there are a number of things about the positive-drive Class "B" system that are rather a nuisance—the need for a driver valve, for an extra power transformer of a rather special type, and anti-oscillation circuits. One loses a good deal of amplification due to the grid drive, and the bias arrangements for the driver (and the Class "B" valve itself, if biased) are tricky. The slightly older Q.P.P. system, using two ordinary output pentodes biased well back, still has claims to be considered; and the combination of two matched pentodes in one container should overcome the leading disadvantage of the system, even although the output for a given H.T. voltage is substantially less than that from a Class "B" stage.

But when we come to the combined Class "B" and driver valve there is a feeling of having reached or even exceeded the reasonable limit of this sort of thing. Apart from a saving of space there is no very obvious advantage to be gained, whereas the disadvantages of multiple valves stand forth at full strength. Doubtless a complete combination suit of clothes in one garment, including underwear, would have considerable novelty value in the apparel market, but it would be unlikely to displace the present apparently inconvenient custom of wearing an assortment of separate garments. The cramping of individual taste in dress, and the need for buying a complete new outfit directly the first sock wore out, would be fatal drawbacks which have their analogies in the valve world.

Better Valves: a Danger

Finally, we consider the recent improvements of existing types; and it can be stated right away that these have not been outstanding during the period under review, because the comprehensiveness of the new classes has rendered most of the previously existing ones obsolete, or at any rate obsolescent. There has been the usual tendency to increase the slopes of valves that are likely to have a future. This has been unostentatiously done for many valves without change of their official designation—a practice that is of questionable value to those who buy replacement valves for old sets. If the slope of a particular type of valve has been increased from, say, 3 mA. per volt to 4 since the original sample was fitted, the difference *ought* not to be enough to cause instability or other trouble if an adequate margin of stability existed at the start; but many examples could be quoted of serious inconvenience having been caused by "improving" the charac-



Most of the new types of output pentode are fitted with a seven-pin base, thus doing away with the inconvenience of the older side terminal.

teristics of a valve without change of designation.

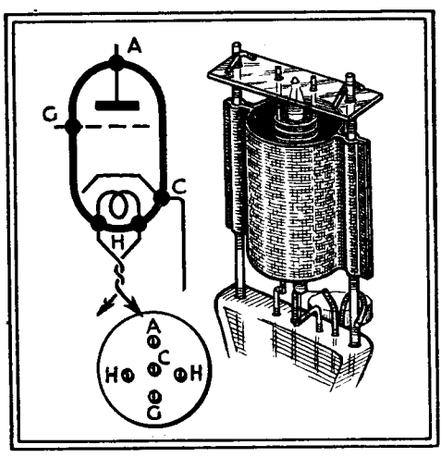
The output pentode is a class that continues to be popular, and it has been found possible to improve it to such an extent as to justify new type numbers; an outstanding example is the Mazda AC2/Pen, which has a slope of 9 mA. per volt instead of the 3 or so that was considered very good a year ago, and

This Year of Valves—

gives an output of no less than 3,400 milliwatts with a grid swing of only 2.7 volts R.M.S. A convenient way of comparing output valves is the "sensitivity" in milliwatts per grid-volts-squared. A few years ago it was not unusual for this figure to be fractional. Last year 50 was about the top figure. For the AC2/Pen it is 485.

"Universal" valves, for A.C. or D.C. indiscriminately, are not new; but during the year the number of types available has been greatly extended, and the valves themselves improved in detail. The class may be taken to include Ostar-Ganz valves, with heaters run in parallel straight from the 200-250 volt A.C. or D.C. mains; and also those intended to be run in series, each taking perhaps 20 volts. The early difficulties caused by having a voltage of 100 or more, up to the full mains voltage, between heater and cathode appear to have been overcome.

The "Catkin" might possibly be claimed to be such a striking departure from previous valve design as to justify inclusion as a new class altogether, but as we are judging them chiefly on the basis of electrical characteristics they are classified here as improvements to existing valves. The electrical characteristics are substantially the same as their counterparts in glass envelopes; the improvements are fairly obvious—compactness, strength, rigidity, and so forth.



Valves with heaters designed for operation at 200 volts or more are now available in various types, and this illustration shows the arrangement of a triode of this class.

A review of the valves existing a year ago is not so much one of promotions, but of retirements. Triodes have been almost completely displaced from the output stage by pentodes, except for quality receivers. They have also been put well on the run from the detector socket, where diodes, S.G. valves, and screened pentodes are contending for favour. The S.G. valve seems to be itself obsolescent, and is everywhere rapidly being superseded by the screened pentode. Many modern receivers have no triodes or S.G. valves—a rather remarkable change from conditions a year or two ago.

Although it has not yet reached the marketable stage, a new development of ordinary classes of valves that may in its time be of importance even to listeners (or at any rate "lookers") is the ultra-short wave miniature valve, about the size of a flash-lamp bulb. With these it has been possible to go down to 0.7 metre wavelength, and even below, using standard methods of transmission and reception.

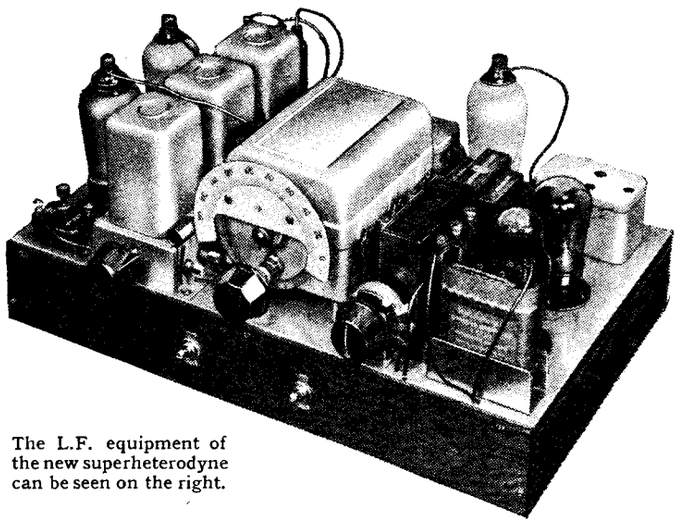
In Next Week's Issue

The Everyman Battery Super

An Economical Five-valve Receiver

THE small superheterodyne has largely displaced the straight set in the case of mains-operated receivers on account of the vast improvement in selectivity and sensitivity which is obtainable. The same tendency is taking place in the battery type of set, although not to the same degree.

The Everyman Battery Super includes a signal-frequency H.F. stage, in which one of the new variable-mu H.F. pentodes is used with two tuned circuits in order to keep second-channel interference at a minimum. The frequency-changer is of the Heptode type, thus permitting a single valve to be employed and giving maximum efficiency, and it is coupled to the variable-mu H.F. pentode, which acts as the I.F. amplifier, by means of an iron-cored I.F. transformer. Another similar transformer is used to feed a pair of Westectors, one of which provides delayed A.V.C. on the three early stages and the other of which acts as the second detector. The L.F. equipment consists of a Class "B" output stage preceded by a driver valve.



The L.F. equipment of the new superheterodyne can be seen on the right.

The adjacent channel selectivity is of a high order, as is also the sensitivity, with the result that good distant reception can be obtained under most conditions. The quality of reproduction, both on radio and gramophone, is very satisfying, and the volume adequate for most purposes.

The receiver is economical in operation, and the Class "B" system and A.V.C. co-operate in maintaining the drain on the H.T. battery at a minimum. Adequate sensitivity and volume are obtainable with an H.T. supply of 120 volts only, but higher voltages can be used if desired.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 Gang Condenser, superhet, with cover and "A" drive — **J.B. No. 2101 Type "F"**
(Polar, Utility)
1 Superhet Aerial Coil — **Wearite Type W.S.A.**
1 Superhet H.F. Transformer — **Wearite Type W.S.H.F.**
1 Superhet Oscillator Coil — **Wearite Type W.S.O.**
2 Ferrocart Colverdynes, 110 kc/s — **Colvern**
(Varley)
1 Screened H.F. choke — **Wearite HFP**
(Bulgin, Kinva)
1 Fixed Condenser, 2 mfds. 750 volts D.C. test — **Peak A3**
3 Fixed Condensers, tubular, 0.1 mfd. 750 volts D.C. test — **Peak Type "M"**
1 Fixed Condenser, tubular, 0.01 mfd. 750 volts D.C. test — **Peak Type "M"**
1 Fixed Condenser, tubular, 0.005 mfd. 750 volts D.C. test — **Peak Type "M"**
4 Fixed Condensers, tubular, 0.0001 mfd. 750 volts D.C. test — **Peak Type "M"**
2 Fixed Condensers, tubular, 0.0002 mfd. 750 volts D.C. test — **Peak Type "M"**
(Dubilier, Graham-Farish, T.C.C., T.M.C.Hydra, Telsen)
1 Pre-set Condenser, 0.002 mfd. — **R.I. "Varicap"**
1 Driver Transformer, 1 to 1 — **Ferranti AF17c**
(Multitone, R.I., Varley)
1 L.F. Choke — **R.I. "Hypercore" DY22**
1 Resistance, 2,000 ohms — **Graham-Farish "Ohmite"**
1 Resistance, 10,000 ohms — **Graham-Farish "Ohmite"**
1 Resistance, 20,000 ohms — **Graham-Farish "Ohmite"**
2 Resistances, 250,000 ohms — **Graham-Farish "Ohmite"**
2 Resistances, 1 megohm — **Graham-Farish "Ohmite"**
2 Resistances, 2 megohms — **Graham-Farish "Ohmite"**
(Dubilier, Erie, Claude Lyons, Seradex, Watmel)
1 Tapered Volume Control, 250,000 ohms and knob — **Claude Lyons 250 M-T**
(Magnum, Rothermel, Watmel)
1 Wire-wound Potentiometer, 400 ohms — **Wearite Q13**
1 S.P. On-off Toggle Switch — **Bulgin S80T**
(Claude Lyons)
1 D.P.D.T. Toggle switch — **Bulgin S.98**
1 4-point Toggle switch — **Bulgin S.87A**
2 5-pin Valve Holders — **Clix Chassis Mounting Standard Type**
4 7-pin Valve Holders — **Clix Chassis Mounting Type**
(Ferranti, W.B.)
2 Westectors — **Westinghouse W.4**
2 G.B. Batteries, 4½ volts
2 G.B. Battery Clips — **Gripso**
(Bulgin)
1 5-way Battery Cable, 30in., with wander plugs and spade ends — **Belling-Lee**
(Bulgin, Goltone)
5 Wander Plugs — **Clix Type "B"**
(Belling-Lee)
4 Terminals, A., E., Pick-up (2) — **Belling-Lee Type "B"**
1 5-way Connector — **Wilburn**
1 5-pin Plug — **Bulgin P.3**
(British Radio Gramophone Co.)
Plymax Baseboard, 9½in. x 16in. x ⅜in. — **Peto-Scott**
1 Bracket for volume control — **Peto-Scott**
1 Bracket for H.F. choke — **Peto-Scott**
2oz. No. 20 tinned copper wire, 6 lengths Systoflex, wood, wire, etc.
Screws:—
2 1in. No. 4 R/hd.; 2 ¾in. No. 6 R/hd.;
6 ½in. No. 4 R/hd.; 10 ¾in. No. 4 C/sk.;
12 ⅝in. No. 4 R/hd.; 30 ¼in. No. 4 R/hd.
Loud Speaker. Rola Type FR5-PM23 for B21 Valve or **W.B. Type PM4A.**
Valves:—2 Marconi or Osram VP21, 1 Ferranti VHT2, 1 Marconi or Osram L21, 1 Marconi or Osram B21.

HINTS and TIPS

Practical Aids to Better Reception

AS a contributor remarked in the pages of this journal a few weeks ago, pure efficiency is unfashionable nowadays in wireless receiver design. Valves are so good that enormous amplification is obtainable even if liberties are taken that would have been considered unpardonable a few years ago.

Avoidable Loss

As an example, it may be news to many readers to know that the solid-dielectric trimmers that are built into ganged tuning condensers often introduce an appreciable loss, the cumulative effect of which, in a three- or four-circuit receiver, is considerable. Where extra amplification—and perhaps extra selectivity as well—would be acceptable, one might well go to the length of devising an air dielectric trimmer—or at any rate one with a dielectric of a better material than is often employed.

THERE is as yet no agreement as to the precise manner in which a distant loud speaker should be connected to the receiver. Possibly the favourite plan is that illustrated in Fig. 1; here the output transformer, instead of being mounted on the speaker chassis, is housed in the set, the speech coil being connected to its secondary winding by extension leads. As most readers are aware, this method offers the advantage that the capacity of the extension leads, even if it be high, will have no harmful effect in reducing high-note response. Again, when an extension speaker is used in addition to one in the receiver, it is obvious that the expense of a second output transformer may be saved, and so, for obvious reasons, the present scheme is favoured for commercial "extension speakers."

Loud Speaker Controversy

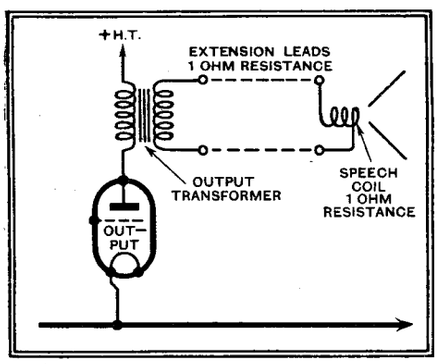


Fig. 1.—Showing the effect of excessive resistance in loud speaker extension leads.

The alternative scheme is to leave the output transformer on the speaker chassis, and to connect its primary winding to the receiver by means of the extension leads. Here the disadvantages are that the capacity in the wiring will be definitely harmful, and, perhaps worse still, leads carrying H.T. voltage will be wandering about the house and may become a source of danger should an insulation breakdown occur.

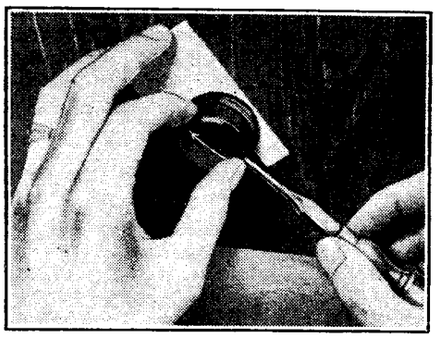
It is worth while to stress the extreme importance of using low-resistance extension leads when the method shown in Fig. 1 is employed, especially if the speech coil is of the usual low-resistance type. A 40ft. length of ordinary domestic twin flex (14 strands of No. 36 S.W.G.) has a resistance of roughly 1 ohm, which is equal to the rating of many speech coils; therefore it would appear that under such conditions one-half of the energy delivered by the output valve would be dissipated in the extension leads, leaving only the other half for actuating the speaker. In practice things are not quite so bad as this, for the reason that the speech coil impedance, so far as impulses of mean speech frequency are concerned, is rather higher than its rating. Nevertheless, there would be quite a serious loss under these conditions.

In view of these facts, it will be evident that a low-resistance speech coil should not be wired with extension leads having a resistance of more than a small fraction of an ohm. Where a long extension lead is necessary, it is infinitely better to use a speech coil of some 10 ohms, for the reason that long leads of extremely low resistance are both cumbersome and expensive.

ALTHOUGH the fitting of a control knob to a projecting spindle would appear to be an easy task, it is not always done properly. The trouble is to get the correct spacing between the inner face of the knob and the front panel; too much spacing is mechanically unsound and unsightly, while with too little there will be a tendency for the knob to rub against the surface of the panel unless everything is dead true.

Control Knobs

As the bush of the knob is usually a loose fit on the spindle, there is generally a tendency for the whole knob to cant sideways as the nipping screw which secures it is tightened. A good way of overcoming these difficulties, and of securing the right spacing without trouble, is illustrated in the accompanying photograph. In a strip of cardboard (of about postcard thickness) a slot is cut of slightly greater width than the maximum diameter of the one-hole fixing bush (or of the spindle when the component is secured to the panel by screws). This slotted piece of card is then placed between the panel and the knob, and the latter is pressed firmly inwards while the nipping screw is tightened up.



A cardboard spacing strip as an aid to fitting a control knob.

WHEN testing a tone-correcting device, or, indeed, when judging the effect of any alteration which is likely to affect quality of reproduction, it is worth while going to the trouble of choosing the right sort of transmission. For example, and to take an extreme case, one would be bitterly disappointed on listening to a xylophone solo after having altered the set in an attempt to improve bass reproduction; a good organ would provide much better material to work on.

Judging Tonal Response

The same principle holds good with regard to the upper register, although it should be borne in mind that many characteristic sounds gain in naturalness through the presence of overtones, which most of us do not easily recognise as such. For checking high-note response, a string quartette is probably as good as anything.

A RECEIVER fitted with A.V.C. does not generally give the usual signs of instability. Almost as soon as the valves break into uncontrollable self-oscillation a high negative bias is applied to their grids from the A.V.C. system, and so a momentary condition of stability is reached. This cycle of events repeats itself with a periodicity depending on the constants of the A.V.C. circuits, etc., and the audible effect is generally very much like that associated with L.F. motor-boating.

Fictitious Motor-boating

If it should be suspected that this state of affairs exists, one's first step should be to disconnect the automatic control. Then, if the trouble be due to H.F. or I.F. instability, it will manifest itself in the usual way by heterodyne whistles; if of an L.F. nature, it will probably undergo no definite change in character.

News of the Week

Current Events in Brief Review

NEW LONG-WAVE PLAN

THE WIRELESS WORLD is able to disclose the tentative plan arrived at last week by the delegates at the Geneva Conference of the International Broadcasting Union.

The plan, which is purely experimental, is being submitted to the respective Governments for ratification, and will be put into immediate practice upon the conclusion of an agreement between Russia and Poland concerning the distribution of certain frequencies.

Radio Paris is to go down in the wavelength scale to 1,648 metres. **Lahti** is to be allowed to retain its present "illicit" wave of 1,796 metres, thus leaving the wavelength of 1,145 metres vacant for some other station if the Air Ministries of Europe agree. **Brasov** and **Huizen** will remain on their present shared wavelength of 1,875 metres.

As already indicated, **Daventry National** will remain on 1,500 metres. **Warsaw, Minsk** and **Kharkov** are left to choose between them which shall use the vacant wavelengths of 1,389 1,339 and 1,293 metres, and it is on this point that Russia and Poland must agree before the new Plan can be put into action. **Konigswusterhausen** (Deutschlandsender) is to retain its wavelength of 1,571 metres.

Luxembourg has vindicated its reputation as an "untouchable" by being allowed to retain the 1,304-metre wave. A more tractable spirit has been shown by France. The French delegate assured the Conference that **Eiffel Tower** would cease transmissions entirely immediately a satisfactory wavelength is found for **Radio Paris**. As the Union considers that the new wavelength for the latter station is likely to prove suitable, it is looking to the French authorities to redeem their promise.

In its present stage the Plan is "private." No attempt is being made to coerce the Governments into accepting it, but the general feeling at Geneva was that agreement would be reached in official circles, if only because all parties are anxious to see an end of the conflict on the long waveband.

Olympia Radio Show

WE understand that the provisional dates for the 1934 National Radio Exhibition at Olympia will be August 16th to the 25th. It is possible, however, that August 17th may be the opening date.

Up-to-date Switzerland

A SPECIAL storey for television and short-wave tests will be included in the new "Broadcasting House" to be erected at Lausanne.

Listen for Muhlacker

THE highest wooden building in Europe—the Muhlacker aerial tower, 623 feet high—has just been completed. It is hoped that the aerial will soon be functioning so that Muhlacker can work on its full power of 100 kW.

The Model Landlord

THE current number of the journal of the Paris Landlords' Association calls attention to the obligation of house-owners to provide lifts and other electrical machinery with anti-static apparatus.

The Wireless Court

CLERKENWELL County Court is notable for its number of cases dealing with wireless sets. An aerial has now been fitted to the roof to facilitate the testing of instruments which are the subject of dispute.

Germany's Unpopular Item

GERMANY'S regional stations have rebelled against the tyranny of the "Stunde der Nation," or National Hour, which has hitherto been simultaneously broadcast on six days a week. The hour, which will henceforth begin later than the usual time of 7 p.m., will be limited to four days a week, permitting the regional stations to arrange longer programmes of their own.

New Interval Signal

RADIO GENEVA has adopted a new interval signal comprising the old Genevese melody "Charles Emmanuel at Atrembières." Programmes open with the Morse signal "R.S.R."

Fishy Question

THE value of broadcasting is discussed in terms of fish-pounds in the Norwegian province of Finmarken, which owns the "unwanted" Vadso station. The listeners in this area argue that the licence fee of 20 kroner corresponds to a catch of 600 pounds of fish, and that the broadcast programmes from Vadso are not worth so much work. The Government retorts, however, that the weather and ice reports, as well as the broadcast news and fish market bulletins, facilitate the catching of fish, and that a mere 600 pounds' worth would be an easy catch for an alert listener. The debate continues.

Tracking Welsh "Pirates"

NEW and more effective apparatus for detecting the presence of radio receivers is said to be in use by the Post Office Research Department at Dollis Hill, N.W. Post office detector vans are now in the South Wales area.

Improving Studio Acoustics

POSTE PARISIEN, one of the most popular of French stations, is experimenting with new studio acoustics. The dummy wooden floor in the main studio is being removed, while the hexagonal supporting pillars are being replaced by the cylindrical type.

Eiffel Tower on Lower Power

EVENTUALLY, we learn, the Eiffel Tower station will conform to the Lucerne Plan, reducing its wavelength to 206 metres. In the meantime an official announcement proclaims that the work of technical transformation will require several months, during which the transmitter must necessarily remain on the long waves. However, to avoid interference troubles, the power output has been halved after 7.30 p.m.

A Presidential Address

SIR AMBROSE FLEMING, M.A., D.Sc., F.R.S., will give his Presidential Address before the Television Society on Wednesday next, March 14th, at 6.30 p.m. at University College, Gower Street, London, W.C.1. The title of the lecture is "Invention in Relation to National Prosperity and Legislative Control." The lecture will follow the annual business meeting. Admission is free by ticket, which may be had on written application to Mr. J. J. Denton, 25, Lisburne Road, Hampstead, London, N.W.3.

No "Dummy" Coils

MR. W. G. MARKS, manager of the Nottingham Passenger Transport Committee, has emphatically denied the allegation that dummy anti-interference coils are fixed on the Corporation trolley buses in order to "fool the public." The Corporation, he states, is still experimenting with stopper coils of various types. Meanwhile, Derby has permanently equipped its trolley buses with stopper coils with great success.

The "Pirate" Conscience

IN a drastic effort to appeal to the consciences of radio "pirates," the Austrian broadcasting organisation has sent a questionnaire to all Austrian citizens asking them to state in writing whether they are listeners or not. It is hoped that very few will tell a lie on paper. Those who confess to listening without a licence will be pardoned on agreeing to pay.

ALL COLOURS AND CREEDS are represented in this crowd of eager listeners to the King's Christmas speech as heard at Kuala Lumpur, Federated Malay States. The radio store prepared for the event by installing a giant public address speaker and correspondingly large baffle.

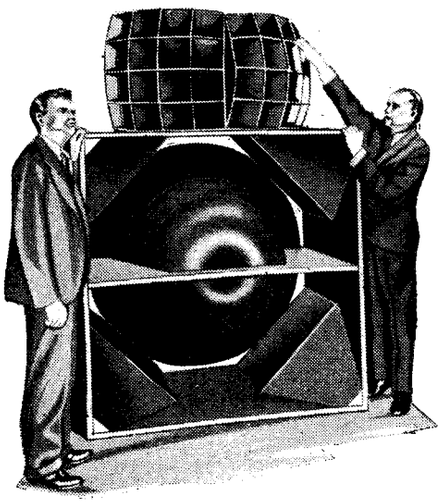
Page 169 follows after the Programme Supplement

Sound Reproduction Progress

THE principles underlying the realistic reproduction of sound are now well understood by scientific workers, but the cost and bulk of the necessary apparatus stands in the way of their full application in broadcast receivers. Nevertheless, recent discoveries have not been without their influence on domestic apparatus, and important improvements are likely to be seen in the near future.

Research Achievements in Relation to Domestic Loud Speaker Design

IF one were asked to say whether the quality of reproduction given by the average wireless set were better than it was twelve months ago there might be reasonable excuse for some hesitation in committing oneself to an opinion. From this it is safe to infer that the improvement, if any, is slight, though the memory in matters acoustical is notoriously short. Such advances as have been made have not yet reached the ordinary listener, but the results achieved have stimulated efforts to bring really high quality sound reproduction within the range of those who can afford to pay £50 or more for their equipment.



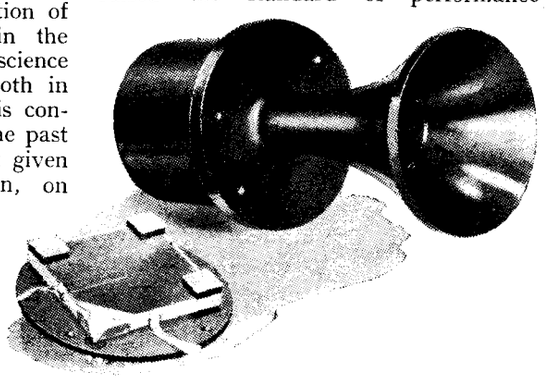
One of the 40-15,000-cycle loud-speaker units used in the demonstration of high quality reproduction at Washington. The high-frequency reproducers are designed to give even distribution of sound over a wide angle.

That well-nigh perfect reproduction of all natural sounds is possible in the present state of electro-acoustic science has been already demonstrated both in this country and America. In this connection the outstanding event of the past year was undoubtedly the concert given in Constitution Hall, Washington, on April 27th, 1933, by the Philadelphia Orchestra, playing in Philadelphia approximately 130 miles away. Three separate groups of loud speakers were arranged on the stage in Washington to give the true auditory perspective, each unit being fed through separate land-lines and amplifiers from three microphones placed in similar relative positions above the orchestra at Philadelphia. The frequency response of each channel, including microphones and loud speakers, was substantially flat from 40 to 15,000 cycles, and each loud speaker unit was capable of handling an input of 150 watts. The volume range of a large symphony orchestra is about 65 db., and the reproducing system was capable of handling differences of 80 db. without recourse to manual volume control.

After the performance of several symphonic works in which the orchestra appeared to occupy the whole stage, Dr. Harvey Fletcher performed several experiments to demonstrate the possibilities of "sterophonic" reproduction. A workman constructing a box on one side of the stage at Philadelphia carried on a conversation while his assistant offered advice and comment from the other side, the loud speakers in Washington giving a faithful perspective reproduction of the whole performance.

Multiple Units

The demonstration was organised by the Bell Telephone Laboratories in conjunction with the American Telegraph and Telephone Company, and although it would be difficult to reproduce the results through the medium of broadcasting, the experiment was justified inasmuch as it raised the standard of performance towards which the manufacturers of high-grade reproducers are working.

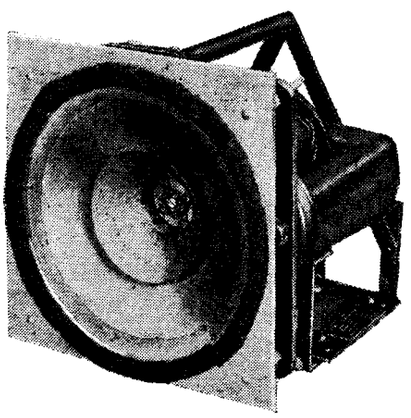


Piezo-electric horn-type loud speaker for frequencies above 3,000 cycles, and (left) crystal drive unit for a cone-diaphragm loud speaker.

The first step to this end is the development of loud speakers having a sufficiently wide frequency range, and in the Washington demonstration horn-type units were employed, the bass from 40 to 300 being handled by a large re-entrant horn, and the treble from 300 to 15,000 by two similar sectionalised horns designed to distribute the sound energy over a wide angle. The principle of sub-dividing the frequency range between two or more units has found increasing favour with designers of domestic receivers, and the introduction of special electrostatic high-frequency units by the Primus Manufacturing Co. and the new piezo-electric reproducers of the Rothermel Corporation, Ltd., has provided excellent material for this purpose.

High-note Reproduction

Many important improvements have been made during the year in single-unit loud speakers, and an interesting example of the direction in which developments are likely to be made in this connection is to be found in the Voigt twin-diaphragm loud speaker. Designed for use in conjunction with a horn baffle, this unit is similar in design to that of a moving-coil cone loud speaker. Inside the main diaphragm and attached directly to the moving coil is a small free-edged cone having a more acute angle than the main cone. The large diaphragm reproduces frequencies up to 4,000 cycles, and the small cone fills in the extreme top above that frequency. The distribution at high frequencies is much wider than would be the case if the energy were radiated from the main diaphragm. Measurements show that the response is aurally flat from about



A subsidiary free-edged cone is employed in the latest Voigt loud speaker to reinforce the extreme top.

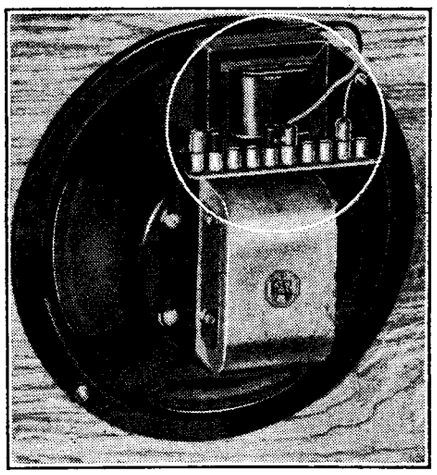
Sound Reproduction Progress—

70 to 8,000 cycles, while there is an appreciable output at 12,000 cycles.

The same problem has been attacked in rather a different way by H. F. Olson, of the R.C.A. Victor Company of America. In appearance the unit is very little different from the standard design of cone-diaphragm moving coils, and the increased frequency response has been achieved by modifications to the moving coil itself. There are two sections joined by a resilient neck, the mass and stiffness of the parts being proportioned to avoid the excessive diminution of amplitude which occurs in the normal design. The diaphragm is of the corrugated type, and has been designed to present an acoustic impedance suited to the special coil drive. The design is well adapted for incorporation in domestic receivers, and experiments with cabinets of suitable design have given an aurally uniform response from 60 to 10,000 cycles.

It will probably be some time before these principles make their appearance in ordinary commercial receivers, as under present conditions a response above 4,000 or 5,000 cycles is detrimental to the enjoyment of foreign programmes, but there should be a market for the quality loud speaker in special sets designed for local station reception where interference is less noticeable in the high frequencies.

Little change is to be noted in the design of moving-coil units for incorporation in receivers, though a substantial decrease in price for an equal performance has resulted from the use of composite chrome and cobalt magnets and improved mass-production methods. On the other hand, an important step forward has been made in the design of extension loud speakers by the adoption of really comprehensive output transformers. The problems of matching are now easily solved by trial and error, and the purchaser can hear for himself when the correct ratio has been found.



A good example of output transformer design —the R and A "Multex"—which gives load impedances from 0.75 to 25 ohms and 1,650 to 24,000 ohms.

The quality of transmissions has shown a steady improvement during the past twelve months, and the almost universal use of moving-coil microphones by the B.B.C. has established a new standard. This is only really appreciated by those fortunate enough to possess a really good loud speaker, but the improvement can often be detected in quite ordinary receivers when successive items are broadcast with the earlier carbon microphones and then with the moving coil.

The research laboratories have already reached the high places of realistic sound reproduction, and it now rests with the development departments to find an easier path to the same level of performance.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

The New Monodial

HAVING constructed the "New Monodial Super," I wish to express my thanks to *The Wireless World* for publishing details of such an efficient receiver. In Scotland here it receives everything possible in the way of radio entertainment. I use it in conjunction with a 2 H.F. Det. 3 L.F. Res. coupled receiver for television reception. I receive splendid results with the combination. WM. R. GIBSON.

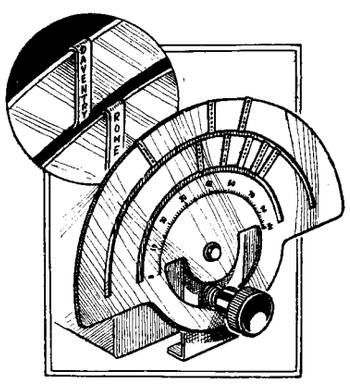
Glasgow, W.4.

I HAVE constructed your very fine receiver, the New Monodial Super, and write to say how delighted I am with the results, for it outclasses anything else I have heard, commercial or otherwise. R. H.

Wallasey.

Tuning Dials

IN view of the interest which has been shown in your columns in the problem of tuning and suitable dials, your readers may like to see an illustration which gives the principle of a new Swedish full-vision tuning dial with loose station name slips, which seems likely to prove very popular in this country.



The manufacturers are Tjernelds Radio, Sveavägen 139, Stockholm.

The arrangement adopted for fixing the name slips to the dial will be obvious from the illustration. BERTIL WOLLERT.

Hedemora, Sweden.

Abandon Long Waves

THE fulfilment of the "Lucerne Plan" has more than ever established the fact that long-wave reception is going from bad to worse.

The long waves are seldom turned to for entertainment. This being so, why do manufacturers continually turn out set after set with the unnecessary provision for long-wave reception in spite of the economies usually effected elsewhere? For example, the reproduction (witness the postage-stamp dimensions of the average L.F. and output transformers).

Some advantages accruing from the elimination of long waves may be mentioned:—

1. Seventy-five per cent. reduction in cost of inductances.
2. Increased efficiency on medium waves due to removal of switching and shorted turns.
3. Elimination of faults due to wave-change switch.
4. Reduction in the number of controls.

In my experience the medium wave-band provides as many alternative programmes with good quality as could be desired.

Isleworth, Middlesex. M. R. BROOKS.

Alternatives to the Disc Record

YOUR correspondent, H. L. Carter, in his letter on sound on film recording, rather exaggerates its disadvantages in his efforts to prove "the lamentable ignorance of the practical problems involved" exhibited by previous correspondents on this subject.

He speaks of shrinking of both negative and positive in development as contributing towards distortion. While I do not possess a knowledge of photography it appears fairly obvious to me that if the images in film photography are sufficiently detailed to be thrown across a smoke-laden theatre on to a screen, where the magnification of the original is anything between 200 and 800 diameters, and the optical distortion is negligible, then the aural distortion introduced by lack of detailed exactness in the slightly magnified image of the sound track must be infinitesimal.

Then, in his reference to noise, he tries to make it appear that a full-size talkie projector, or at least an instrument comparable in noisy working, would be used for home entertainment. This is ridiculous, the noise of a cinema projector is of no importance, and no attempt is made to keep it low. A small motor with the associate mechanism required to drive a film at an even rate could be as quiet as any gramophone motor. The noise of the film itself engaging the sprockets would not be there, since the film would move at an even rate and the sprocket drive common to optical film projectors would be unnecessary.

Furthermore, expensive mechanical gear would not be needed to prevent flutter. The system you illustrated recently, where the film is run between pairs of rollers, would ensure even pace simply and cheaply.

Certainly an expensive optical system is to be preferred, but just as a reasonably good camera can be made quite cheaply, so an optical system more efficient than the amplifying equipment could be made at a reasonable price. E. HURRAN.

Plaistow, E.13.

OBSOLESCENT

DO YOU OWN A MUSEUM PIECE?

EVEN if a 1930 set cannot be converted into a 1934 model, a few at least of its less attractive features can usually be modified to improve performance under modern conditions.

ALTHOUGH there are unquestionably far too many antique sets in use at the present day, it is not the purpose of this article to suggest ways and means to bring them up to date in every detail. That would be impossible in most cases, and even if it could be done, the subject is not one that can be treated in general terms. But if we cannot turn our old sets into new ones, we can at least remedy their most obvious defects by modifying those details that have been proved beyond question or controversy to be unsuitable for broadcasting conditions as they exist to-day.

It is logical to make a start with the single tuned circuit which is still to be found in a vast number of simple L.F.-detector sets (without H.F. amplification). Under particularly favourable conditions, such an arrangement is capable of satisfying the unexacting requirements of those who ask for little more than the local station. Where conditions are not favourable it will hardly give that, at any rate in a satisfactory manner.

As was pointed out in an article which appeared in *The Wireless World* for December 29th, matters can be improved in this respect by substituting one of the modern iron-cored tuning coils. Those who are prepared to go to greater lengths to improve their sets are advised to abandon the principle of single-circuit tuning altogether and to avail themselves of the vastly greater selectivity inherent in a two-circuit tuner, like that illustrated in Fig. 1 (*b*). There will, theoretically at any rate, be a slight falling-off in sensitivity, but usually this is compensated for by the fact that one can work with a closer aerial coupling and still have much better selectivity than before. Again, the loss will in any case be very small indeed if good iron-cored coils are chosen; they are certainly to be strongly recommended for this purpose, not only on the score of efficiency, but also because they are so compact.

This brings us to the practical consideration of space, as room must be found for an extra tuning coil, and also for a two-section ganged condenser in place of a single condenser. Some modern two-gang condensers—and good ones at that—are hardly any bigger than the old type of single condenser, and so things should turn out better than might be anticipated.

It goes almost without saying that the coils will be screened, but means must be provided for linking together electrically the circuits of which they form a part. At a pinch, a pair of standard band-pass coils, complete with the particular form of coupling advocated by the manufacturer, may be used, but in a tuner of this description it is rather better to use—or at any rate to have provision for—rather looser coupling, and the use of a small coupling condenser (CC in the diagram) is to be recommended. Make certain that this condenser has a really low minimum capacity; its maximum need not exceed some 10 or 20 micro-microfarads. If any difficulty is found in obtaining the right sort of component, one can be improvised by stripping down a small reaction condenser.

A trimming condenser, controllable from the front panel, is a desirable addi-

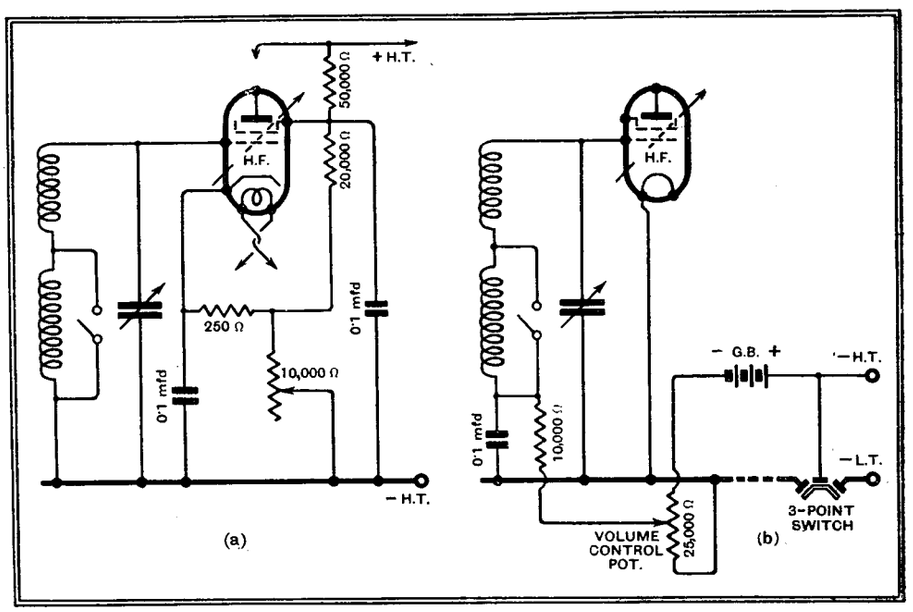


Fig. 2.—Adjustable grid bias and variable-mu H.F. valves provide the best volume control; the necessary additions and alterations are easily made to existing sets.

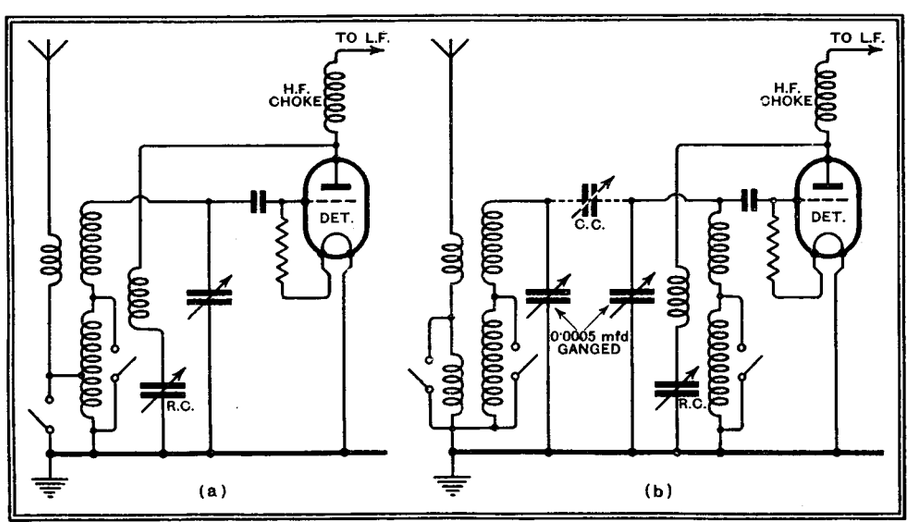


Fig. 1.—The surest way of improving true selectivity is to use more tuned circuits. Diagram (a) shows a typical single-circuit tuner that is seldom good enough for modern conditions while diagram (b) represents a greatly improved arrangement.

Obsolescent—

tion; it may be connected either across the aerial or secondary circuit, and experiment will show which is best. Many ganged condensers are obtainable with a built-in trimmer, adjustable through a concentric knob.

Many sets of the older type have no provision for volume control, or else are fitted with a form of control that is quite unsuited for modern needs. For instance,

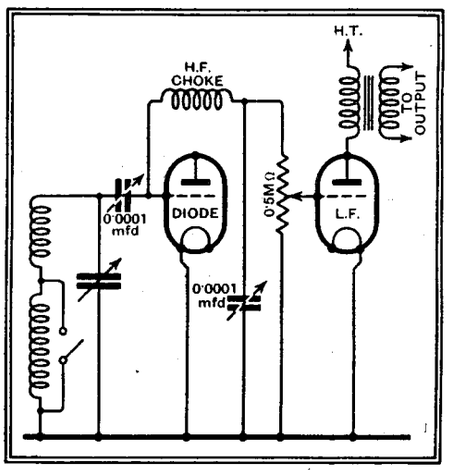


Fig. 3.—A diode rectifier may with advantage replace an anode-bend detector, especially in non-reacting receivers.

a control which operates simply by varying the input from the aerial is likely to disturb tuning, and perhaps worse still, it tends to make the ratio between signal and background noises worse than it need be. Such a form of control is now out of place except in conjunction with one or two highly specialised circuits, or in the simplest type of detector-L.F. set, where requirements are not usually exacting.

So far as receivers with H.F. amplification are concerned, it is easy to fit a satisfactory form of volume control by replacing the ordinary S.G. valve by one of the variable-mu type, and at the same time providing means of varying its grid bias. Such a control works smoothly and well, and has practically no objectionable features.

Fitting Variable-mu H.F. Valves

Conventional methods of providing variable bias for A.C. mains and battery valves are shown diagrammatically in Fig. 2. With regard to diagram (*a*), it should be realised that the values of the resistance network will vary with different valves, and indeed some manufacturers recommend a rather different arrangement. In any case, full particulars are issued by the valve-makers as to the arrangements that are best for their own particular products.

Many of us have a sneaking affection for anode-bend detection, but it must be admitted to have few real attractions in the modern set, except as the first detector of a superheterodyne. Even to the musically uneducated ear, the "roughness" which it generally introduces on deeply modulated transmissions is painfully obvious. One is somewhat at a loss to suggest the best all-round alternative for it. If reaction is employed, it will probably be most satisfactory to change over to grid detection, using the values of condenser and grid leak that are specified for modern receivers, and at the same time altering the detector anode components to conform with present-day practice. Even so, there may be some falling-off in selectivity.

Where there is no reaction, the fitting of a diode detector, as shown in Fig. 3, can be confidently recommended; the set will "handle" just as nicely as before, and, providing an extra L.F. valve be added to make good the loss of sensitivity, there should be no falling off in range. It should be made clear that this extra valve should only be added where the detector originally fed directly into the output valve, and not to receivers which originally included two L.F. stages—three stages in all would be excessive.

A diode valve works best with a large input, and so it is desirable that a post-detection volume control should be fitted. This can conveniently take the form of a potentiometer (as illustrated in the diagram), which also serves as the diode load resistance. With battery valves the L.F. amplifier which succeeds the diode will be self-biased, but with indirectly heated mains valves, a small "standing" bias must be provided by fitting a cathode resistor in the usual way.

The advantages of the modern battery-economy systems are so well known to readers that it is hardly necessary to enter a plea here for their inclusion in battery receivers which have not already been converted. The change-over is so easily made that there is little excuse for having neglected to do it; with regard to the financial aspects of the question, it may well prove an economy in the long run, as the cost of battery upkeep will probably be reduced.

Add A.V.C. to Superhets

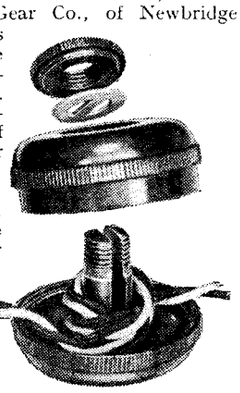
The benefits conferred by automatic volume control need hardly be stressed, and certainly every set with pretensions as to range should be so fitted. So far as superheterodynes are concerned, the commercial units which include a metal rectifier are entirely satisfactory and easily connected. Straight sets, on the other hand, present a more difficult problem; various methods have been suggested from time to time in this journal, but one rather doubts if anything has yet been devised which is simple and inexpensive enough for general use. Probably the best plan is to fit a diode-triode valve, adopting the general circuit arrangement of the A.V.C. Three, described in *The Wireless World* of October 13th and 20th, 1933.

The Radio Industry

SPECIAL Every Ready replacement batteries of the correct voltage and with suitable tappings for the following sets are announced: Portadyne B.72, Philips 834B, Pegasus 1660, Bush SB.1.

Moulded cabinets for Ekco receivers caused a good deal of interest at the British Industries Fair. Much progress is evidently being made in this branch of the plastic art, and we gather that eminent artists are being commissioned to prepare new designs in collaboration with radio technicians.

A neat and useful "cord shortener," made by the Horsmann Gear Co., of Newbridge Works, Bath, is illustrated in the accompanying "exploded" photograph. It is intended for adjusting the length of flexible loud speaker extension leads, etc.



A bakelite spool for adjusting the length of flexible leads.

The latest list (No. D.W.5) issued by the Fuller Accumulator Co. shows considerably reduced prcies for the Triple high tension batteries, and also for the standard L.T. accumulator cells.

The Copper Development Association, of Thames House, Millbank, London, S.W.1, is a non-commercial body which has as its object the encouragement of the use of copper. The Association is closely in touch with research workers all over the world, and acts as a clearing house for the dissemination of information.

A new list just issued by the Telegraph Condenser Co., of Wales Farm Road, North Acton, London, W.3, contains details of all T.C.C. condensers, and also of the recently introduced disturbance suppressor.

Jackson Brothers, Ltd., of 72, St. Thomas Street, London Bridge, London, S.E.1, are issuing free blue-prints showing the construction of battery and A.C. three-valve sets in which the J.B. Linacore tuning units are employed.

Peto-Scott Co., Ltd., of 77, City Road, London, E.C.1, have for some time taken a practical interest in television development, and are already producing a number of special components and accessories, such as scanning discs, motors, synchronising gears, mirror drum parts, etc. Their activities in this direction are likely to be considerably extended in the near future.

CATALOGUES RECEIVED

Mullard Wireless Service Co., Ltd., Mullard House, Charing Cross Road, London, W.C.2.—Rapid Valve Guide, 1933-34. Third edition, including latest types.

Rich and Bundy, Ltd., New Road, Ponders End, Middlesex.—Power transformers and chokes, duo-phase transformers, and the "dimmer tuner."

F. W. Lechner and Co., 61, Spencer Street, London, E.C.1.—Kabi radio components.

Loewe Radio Co., Ltd., Fountayne Road, Tottenham, London, N.15.—Leaflets describing pick-ups, special set components, paper condensers, and a new midget P.M. moving-coil loud speaker.

Broadcast Brevities

By Our Special Correspondent

B.B.C.'s New Recording Experiments

DESPITE statements that the Blattnerphone is the only method of recording now used in British broadcasting, I can say that "hush-hush" experiments are being conducted at Broadcasting House with wax-faced discs composed of a metal alloy. Their use promises to open up new possibilities, for, unlike the Blattnerphone record, which must be wound back before the sound is reproduced, the discs can be played over immediately.

Although 10 inches in diameter, they can, of course, be used for mere scraps of discourse; an announcer may improve his "Good-night, everyone; good-night!" by recording the words and playing them over a moment later, repeating the process *ad nauseam*.

Six "Play-Backs" Possible

If officially approved, the discs will be used primarily for rehearsal purposes, but it would not be surprising if they figured in actual broadcasts. Reproduction is excellent on the first play-back, and is passable even at the sixth time of asking.

Two makes are being experimented with, one British and the other German. May the better one win!

Charles Laughton at the Microphone

A MICROPHONE début of rare interest occurs on Sunday, April 8th, when Charles Laughton, the famous character actor, will take the name part in "Macbeth," to be broadcast from the studio by the Old Vic Company under the direction of Tyrone Guthrie.

Laughton has already conquered the stage and the screen, and one can have little doubt that his microphone success is equally secure.

Back to the Clock Tick ?

HAVING experimented with Bow Bells as an interval signal, the B.B.C. is strongly inclined to revert to the clock tick. Once or twice recently it has been felt that the sudden peal of joy bells has jarred on the preceding programme.

Ticks—with a Difference

A clock tick is unbiased. It can maintain the mood of a funeral oration or stimulate the listener's sense of suspense before a thriller or a variety show. But why not use a metronome, giving a different rate of beat for each B.B.C. station?

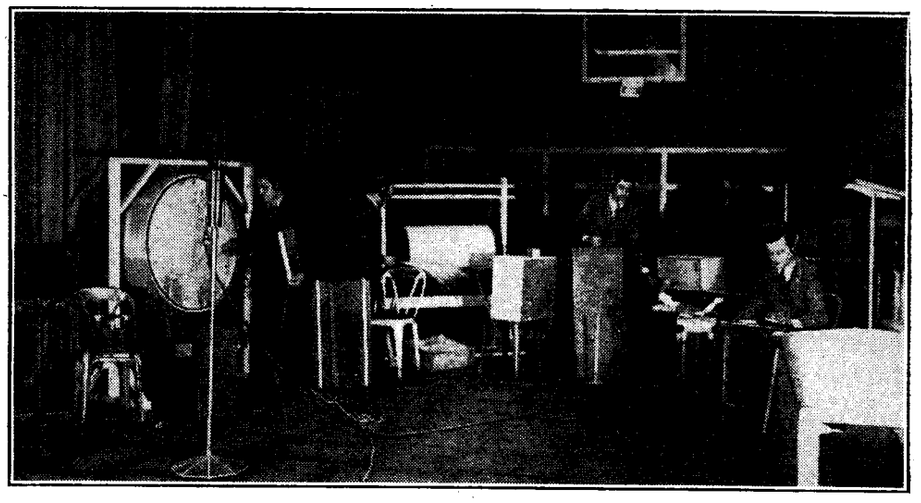
They Want a Holiday

SHREWD common sense, more than motherly benevolence, seems to be behind the B.B.C. scheme for sending staff veterans on a paid holiday after ten years' service. Without being unkind, one may say that quite a lot of B.B.C. men seem to need a "refresher"—who would not, after ten years of creative striving under the administrative thumb?

Not Enough Money ?

The only murmur of objection I have heard concerns the amount of the holiday bonus, which, I understand, is in the region of 10 per cent. additional salary over a three-monthly period. Is it enough to make the holiday worth while?

The answer seems to lie in the fact that no one has yet refused the offer.



THUNDERSTORMS AT SEA can be manufactured with ease in this new "effects" studio at the Paris P.T.T. broadcasting station. The swish of rain, roar of thunder and crack of lightning were all being produced at the moment this photograph was taken.

I Hear That . . .

A FAMOUS showman—name a household word—has taken umbrage at the remark of a B.B.C. dramatic critic concerning the choice of a stage star. In consequence not only has he cut all personal connection with broadcasting, but he is issuing instructions that no stars bound by his contracts shall appear before the microphone.

An interesting situation.

Half-baked Vaudeville Shows

THE mystery is not that some broadcast shows are bad, but that any of them are really good.

I venture to suggest that the forthcoming film of Broadcasting House will remain discreetly blind to the conditions under which B.B.C. producers work in their cramped offices. In one particular room three producers do, or try to do, their work. There are four or five telephones, messengers arrive and depart, musical numbers are tried out on the piano in the corner, and "stars" are interviewed in the other corner; in fact, everything is calculated to interfere with sound creative effort.

Dr. Boult's Silent Piano

John Watt, by the way, is the only producer who dare play a piano outside the studios; even Dr. Boult's instrument is eternally silent because, in the room underneath, sits A HIGHER OFFICIAL.

An "Impossible" Orchestra

CHRISTOPHER STONE will be the announcer in a novel programme from the National transmitters on March 26th when a really "All-Star" Orchestra, under Van Phillips, will present an hour of popular music in the modern manner. This superb orchestra will include Leon Goossens (Oboe), Sidonie Goossens (Harp), Hugo Rignold (Violin), Anthony Pini (Violincello), Arthur Young (Pianoforte) and Rudy Starita (Xylophone).

This would be an impossible combination for any leader to maintain—the salary list would be prohibitive.

The Grand National

THE Grand National broadcast takes place on March 23rd and the usual pair of experts will tell listeners all about it, yard by yard, between the Grand Stand and the Canal turn. Mr. Lyle and Mr. Hobbiss have been sharing the task of describing the race since 1930, as it would be found to be impossible for the commentator at the Grand Stand to distinguish the horses nearly a mile out "in the country."

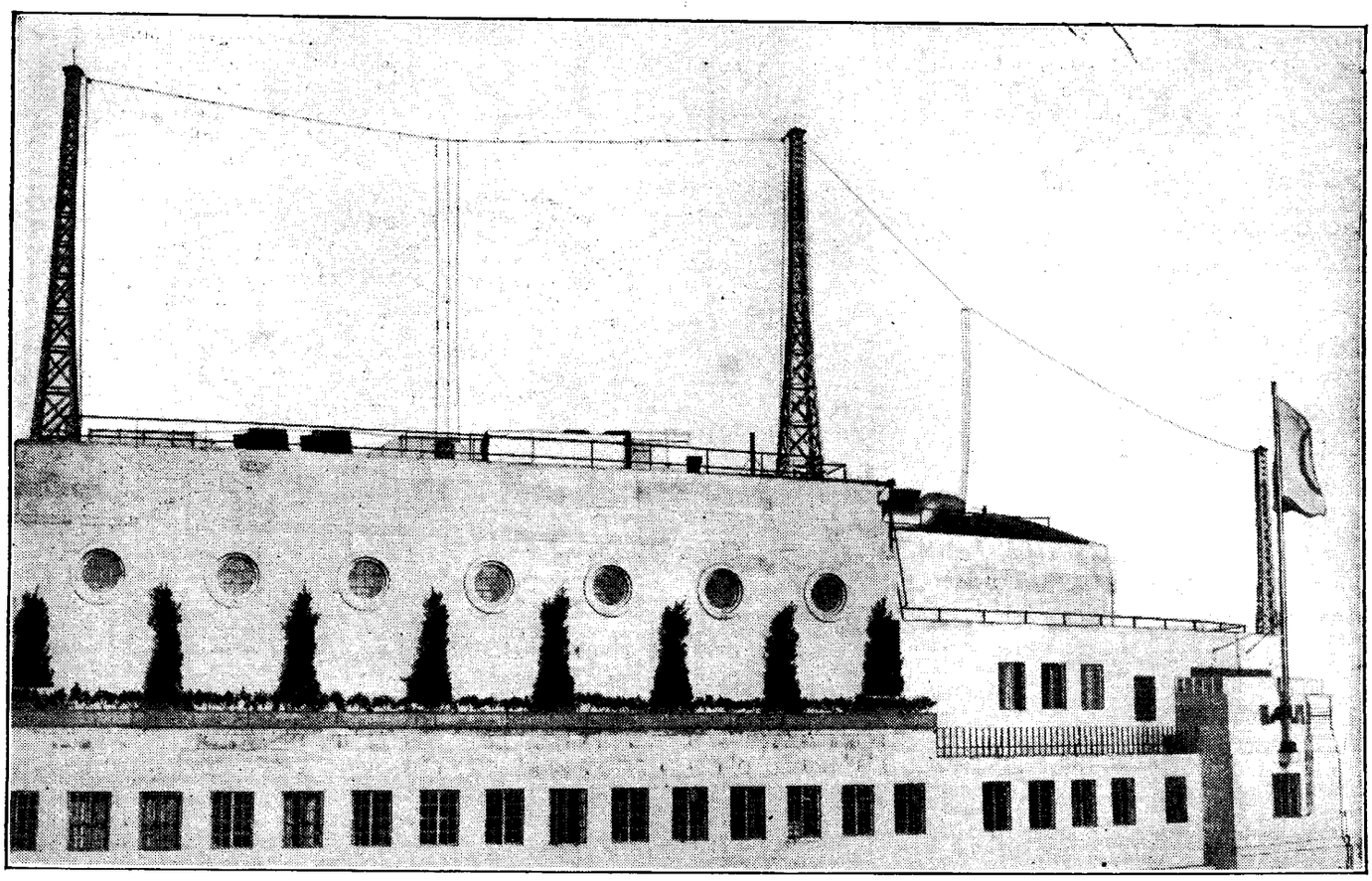
Three circuits are installed between the van and the control point in the Grand Stand—one for the commentary from the Canal turn, one for control and one so that those on the van can hear the Grand Stand commentary and know when to "fade in" each speaker.

Television : The Problem

STANDING last week in the fibre-walled "drawing-room" of 16, Portland Place, where Mr. Eustace Robb has set up his television stage and 30-line equipment, I could not help wondering why it had been decided to reduce the evening transmissions to two a week. Never before have conditions been more favourable for the production of good television programmes. Mr. Robb explained to me how much benefit would accrue from the greater space now available for the artistes and how much the engineers appreciate having a little elbow room instead of, as at Broadcasting House, being cooped up in a small den some 6 feet by 10 feet.

Scanning Lends Enchantment

I was privileged to swing the scanning beam over the lithe figures of the Eight Step Sisters, and in the studio, at least, the 30-line flicker only served to enhance the shimmering beauty of the scene.



The 7-metre aerial systems on the roof of Broadcasting House. *Wireless World Photo.*

Television Prospects

Some Thoughts on the Present Position and Tendencies

THE account of the new Cossor television system in a recent issue marks an interesting point for a brief review of the present position of television. For one thing it draws attention to the cathode ray oscillograph in modern television. A particular feature of the velocity-modulation system used by Cossors is that it is only applicable to cathode ray methods *both at transmitter and receiver*. Apart from this, however, it is obvious that the cathode ray tube is the favourite starter for the realisation of television on 120 or more scanning lines.

Incidentally, in answer to those who feel or fear that the cathode ray oscillograph is too delicate or tricky a device for general use, it is interesting to quote an opinion expressed by the authors of a recent text-book on the use of the instrument in wireless researches (other than television). They say: "We have frequently been impressed by the existence of a feeling that the oscillograph itself is an expensive and fragile device. We ascribe the feeling to a failure to recognise the very rapid improvements of the last few years and the very rapid and continuing process of price-reduction which has accompanied these improvements and the consequent growth of demand. We think that the oscillograph may now fairly be described as robust and inexpensive. The electron gun is a triode, of the same general nature and with the same general standard of robustness as the familiar receiving triode." Comforting words!

Future Hopes

Reverting, then, to its use in television, it is generally admitted that the 30-line transmissions sent out by the B.B.C. on its evening transmissions are unlikely to show much improvement in quality and that the future of good-quality television lies in the higher scanning speeds, necessitating the use of the shorter waves to obtain the width of frequency band. The tests on 7 metres from the transmitter on the top of Broadcasting House—first by the Baird Company and at present by the H.M.V. Company—are of higher scanning speeds. We believe that speeds from 120 to 180 lines were used in the Baird tests. The H.M.V. system certainly uses not less than 120 lines. Both systems are intended for cathode ray reproduction, using the more usual method of intensity modulation. (The Cossor system previously described was also for not less than a 120-line scan.)

It is not to be inferred that these remarks are intended to convey that light-modulation systems are incapable of development up to these scanning speeds. It does mean, however, that those working on the problem are looking to the cathode ray tube as the first and most direct solution of reception at moderately high scanning rates.

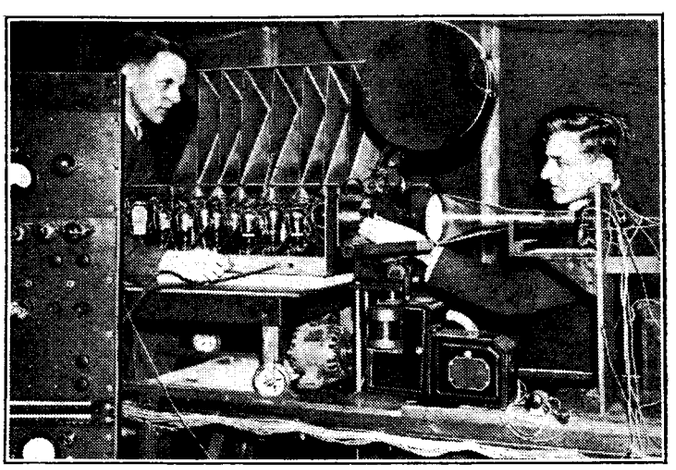
A feature which is claimed for the Cossor system is that it employs ordinary commercial oscillographs, with the velocity-modulation method as its main feature and utilising a proportion of intensity-modulation merely for improvement and intensification of the velocity-modulation. With the ordinary type of measuring oscillograph this is undoubtedly important because these tubes are not well adapted for any high degree of intensity modulation, that is, they are not capable of giving a high degree of light and shade contrast without being accompanied by considerable variation of focus of the spot. Against this, it is to be remembered that the development of tubes for intensity modulation is well advanced. Zworykin, who has worked on this subject a great deal in America, has produced his iconoscope—a receiving tube with its

Television Prospects—

control electrode capable of giving a very wide degree of intensity variation about a mean value, with a completely satisfactory linear response. We have no information on the position which has been reached in this country—none, indeed, has been published—but the association of the H.M.V. Company with the American interests of Zworykin is well known.

Synchronisation

A notable feature of the velocity modulation is the simplification of line-scanning synchronisation, which is additionally capable of having the picture-repetition synchronisation superimposed on it. Another important possibility of synchronisation lies in the use of the 50-cycle mains network. This method is already in use to a certain extent in the Cossor system by using these mains to produce a submultiple at 25 lines per second, which serves as a timing impulse for the framing at the transmitter circuit. The film is driven by a 50-cycle synchronous motor and "phased" so that the timing impulses occur in the blanks between pictures. The method of synchronising a transmitter and cathode ray receiver is already in use in experimental work on the Heaviside layer, and has been used at distances of at least twelve miles between transmitter and receiver, so long as these are on the same frequency of supply. So far, the method has not been tried for television synchronisation, at least, in this country, but the scheme seems a perfectly practicable one. The transmitter and receiver must be on exactly the same frequency—that is, the supply to both must be controlled from the same generating station. Otherwise, the framing will be in a continual state of drifting, according to the difference between the two frequencies. The spread of the "grid" system is leading to the synchronised condition, but, even apart from it, an important feature is that the use of 7-metre waves will give the transmitter only a limited local range, over which the same supply is almost certain to extend.



The cathode ray tube and associated apparatus at the transmitter of the Cossor television system.

The Cossor system and, so far as we know, also the Baird and H.M.V. systems on 120 lines or more are arranged for transmission of film. At first sight this appears a disadvantage, in that it prevents the direct televising of an actual scene. As a matter of fact, the disadvantage is more apparent than real. In the first place, there is a definite advantage in working from film, in that the photo-cell and scanning system work under more definite and constant conditions. The photographic side of the process is frankly in a better state of development than is the photo-electrical, and existing photographic technique permits a wonderfully good film to be taken under difficult and varying conditions. Witness the news reels!

In the second place, modern methods now permit us to transmit the film within one or, at the most, two minutes of its being taken. Processes of high-speed development, fixing, washing and drying have now reached quite an advanced state, and it is within existing methods to photograph a scene and develop and scan the film in the television transmitter within the time stated above. It is well known in the picture-making industry that celluloid is about the least expensive of all the costs that go to make up a production. In the television case it is also not unlikely that the interposition of celluloid is not considered a prohibitively expensive matter compared with other costs, and compared also with the advantages of using the intermediary. Moreover, it is quite likely that narrow and inexpensive film would be good enough for television quality, at least, for some time to come.

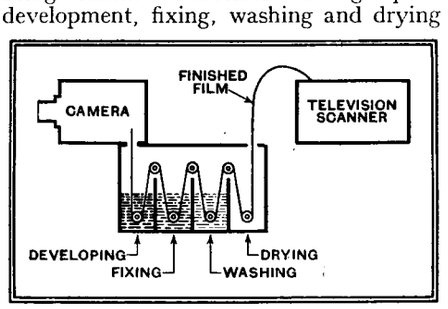
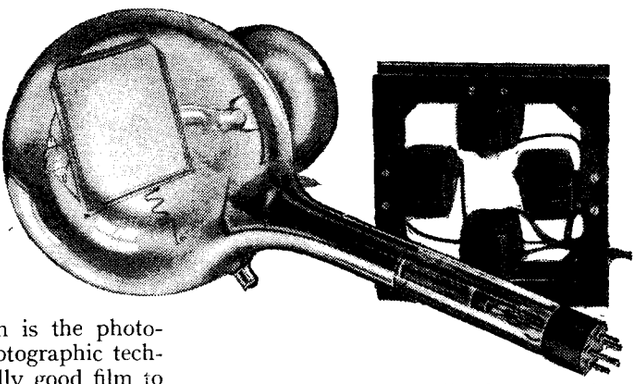


Diagram to illustrate the principle of scanning a film, for purposes of television, shortly after it has been exposed in the cinematograph camera.

There still remains the difficulty that even the short delay times mentioned above have the apparent effect of precluding the simultaneous transmission of sight and sound in the case of a directly viewed scene, since the vision must go through the delaying intermediary of the film processing. This disadvantage is neither real nor serious. The answer is that the sound can be given exactly the same delay as the sight. One possible way is, of course, to use ordinary "talkie" sound recording on film, so that sound and sight are recorded together and transmitted together. A possible disadvantage is that the sight alone might be workable on narrow film, as suggested above, while 35 mm. film would almost certainly be required to accommodate sound and sight together. A simple and attractive alternative, however, is the temporary storage of the sound on a steel tape of the Blattnerphone type, which is given the same delay as the film and synchronised to it—no great difficulty. This is by no means expensive, since the tape can be wiped out and used time and again.



Zworykin's "iconoscope." The rectangular plate shown in the tube consists of a mosaic where each element is a miniature photo-electric cell. External deflecting coils are shown to the right.

It is understood that developments on the lines suggested above are now in progress; certainly the present indications are all towards interesting developments in the fairly near future.

Lastly, it must not be thought that cathode ray television is necessarily limited to film transmissions. Zworykin's "iconoscope" is a remarkable tube, which is capable of being applied to a direct scene and focusing a real image of it on to a special fluorescent screen, which also acts as a light-modulating photo-cell of multi-cellular structure. Here, too, interesting developments may be looked for.

BLUE PRINTS

For the convenience of constructors full-sized blue prints are available of *Wireless World* sets, price 1s. 6d., post free, including the following:—

New Monodial Super. (July 21st and 28th, 1933.)

Universal A.C. Short-wave Converter. (April 28th, 1933.)

Everyman A.C. Super. (December 22nd and 29th, 1933.)

Battery H.F. Pentode Four. (February 23rd and March 2nd, 1934.)

Quiescent Push-Pull Three. (March 2nd, 1934.)

These can be obtained from the Publishers, Iliffe & Sons Limited, Dorset House, Stamford Street, London, S.E.1.

UNBIASED

This week our distinguished contributor enhances his reputation for up-to-dateness. The following article appears to have been written for publication in the year 1947.

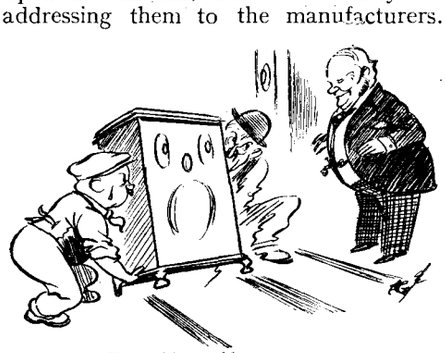
By FREE GRID

NOW that we are all so busy celebrating the silver jubilee of broadcasting, it is, I think, not out of place for us to look back across the gulf of years and see exactly what progress has been achieved.

I think I am right in saying that, although broadcasting began in 1922, it was not until 1930 that any real progress—using the word in its modern sense—was made in receiver design. It was about then that I commented on the fact that would-be set owners had to go through the old-world ceremony of receiving, testing and returning at least three or four sets before they ultimately received the final and working model. By a special dispensation of Providence this usually managed to hold together until the next show when, of course, it was incumbent upon any decent-minded citizen to order a new one and thus keep away the big bad wolf who was for ever menacing the humble cottage of the manufacturer.

The reason for this strange ceremony was that manufacturers, when sending out their sets, usually omitted a few soldered joints, grid leaks and other small important things, as those of you who are privileged to wear the old Voronoffian tie may remember. A little later these early deliveries were sent out with dummy valves, since it was quite rightly thought that as the sets wouldn't work and would have to be returned in any case, it was not worth the risk of sending out good valves in any but the working model.

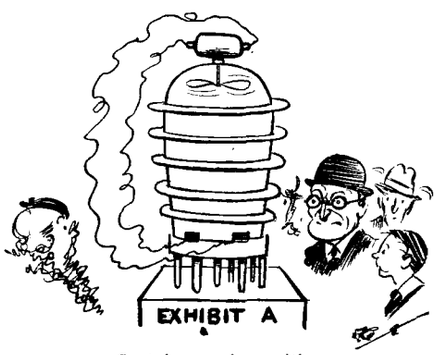
Eventually, however, one great Captain of industry found out that the general public were not even bothering to open the cartons, but were merely re-addressing them to the manufacturers.



The old-world ceremony.

As the result of this, he was struck with the brilliant idea of decreasing manufacturing costs by merely sending out empty cartons. At last the public became so accustomed to this process that they automatically sent back the final carton also, which, of course, contained the receiver. The result is that at the present day we have been brought to the *reductio ad absurdum*, the whole twelve months between wireless exhibitions being occupied by the interchange of cartons between vendor and buyer.

Turning now to another aspect of radio progress, I am reminded that in the autumn of 1932 special coils were produced which had a core consisting of a number of finely divided iron particles. The immediate effect of this was to swell the bank balances of radio manufacturers, although, I would hasten to add, in a perfectly legitimate manner, since these special iron cores did really bring about a great increase in efficiency. Unfortunately, however, the manufacture of coils of this type in vast quantities presented certain practical difficulties and the cost of production was by no means negligible. It was not surprising, therefore, that coils began to appear in which chunks of ordinary iron were used. Since the public were demanding iron-cored coils, and these were unmistakably iron-cored, it could not be said, of course, that any act of dishonesty was committed.



Certain carping critics.

Another noteworthy invention was the all-metal valve, the advantages of which were greater rigidity and greater power dissipation, the latter being due to the large cooling surface which was made available by using the metal envelope as the anode. Similar effects were also provided by a special shaping of existing glass envelopes, cooling effects being added later by the simple expedient of building a miniature electric fan into each valve and affixing cooling fins after the manner of the old motor cycle engine. Certain carping critics denounced the latter procedure on the grounds that there was no air in the valve which the fans could stir up, but a spirited reply was given by their sponsors, who pointed with pride to the blue glow in their products as definite disproof of this nonsensical statement.

Yet another epoch-making invention was that of an enterprising commercial magnate who succeeded in making two loud speakers do the work of one. At first, it must be confessed, loud speakers were so poor in the frequency range which they covered individually that a real advantage was obtained by this arrangement. Later, however, there were revelations in a certain Sunday journal to the effect that individual loud-speaker characteristics had improved so greatly that better results were likely to be obtained with one than with two.

Progress Went On . . .

Naturally, something had to be done to stop the spread of this heresy, and manufacturers acted swiftly by producing loud speakers in which measures were introduced to decrease their frequency response to such an extent that the use of at least twelve loud speakers became imperative.

Progress went on, as it usually does, until finally it became necessary to use some thousands of loud speakers, one for each individual frequency. Matters came to a deadlock when one enterprising manufacturer descended into the infinite and produced an instrument with a frequency response which was infinitely small, the net result being, of course, that nothing was heard at all. In view of the nature of the programmes then broadcast, this was an advantage rather than otherwise.

Taking all things into consideration, however, I must award the conventional biscuit to the valve makers for their great multiple valve stunt. Starting with an invention of genuine technical merit, namely, the Pentagrid, they soon commenced turning out all sorts and combinations of valves. Later, various coupling components began to be mounted in these multiple valves until to-day everything, including tuning coils and condensers, is inside the glass envelope. This has completely solved the old problem of servicing, since, if anything goes wrong, the set owner has merely to plug in a new valve, and even Aunt Agatha is capable of doing this. As the valve makers' advertising slogan puts it, "With every valve, a new set."

Nothing was heard at all.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Interference Legislation

An Appeal to the P.M.G.

IT is now over three years since *The Wireless World* started the campaign to get the nuisance of electrical interference with broadcast reception dealt with on proper lines. It is also sixteen months since we suggested that the Institution of Electrical Engineers, as the representative body of the electrical industry, should appoint a committee to investigate the question. It must be said—to the credit of the I.E.E.—that the invitation was taken up with commendable promptitude, for the Committee was actually appointed a few weeks after our suggestion had been made.

But what is happening now? The I.E.E. is beginning to lose the confidence which listeners originally placed in its ability to see the business through. Letters keep coming in from disappointed areas all over the country where electrical interference continues, despite the help of engineers of the Post Office who are known to have been in the neighbourhood and given the owners of the offending plant the information necessary to enable them to suppress the nuisance.

The public cannot be expected to wait indefinitely for the I.E.E. Committee. Legislation to control interference must come, and if the electrical industry procrastinates or is unwilling to co-operate then a move must be made without this co-operation.

The longer matters are allowed to drift on the worse becomes the situation for everyone concerned. New electrical undertakings are continually in progress and the distribution of interfering electrical appliances grows daily.

Manchester, one would imagine, should set an example, yet here we have recently been told of an instance where serious interference is caused by certain electrical signalling plant, and, to the exasperation of listeners in the district, the Corporation declines to effect any remedy. Again, in Sheffield a proposal is on foot to make a big extension in the city's tramway scheme, but a suggestion that interference suppressors should be fitted has been met by a proposal from one Councillor that either the cost should be covered by the B.B.C., or nothing should be done. The absurdity of such a suggestion scarcely requires to be pointed out. No single body such as the B.B.C. could possibly be expected to bear the cost of fitting interference-eliminating devices to plant throughout the country, but no unreasonable burden has to be shouldered if each individual plant is rendered innocuous by those responsible for it.

Set a Time Limit

Why should this country lag behind its neighbours in this matter? On the Continent most countries have already got legislation to control interference.

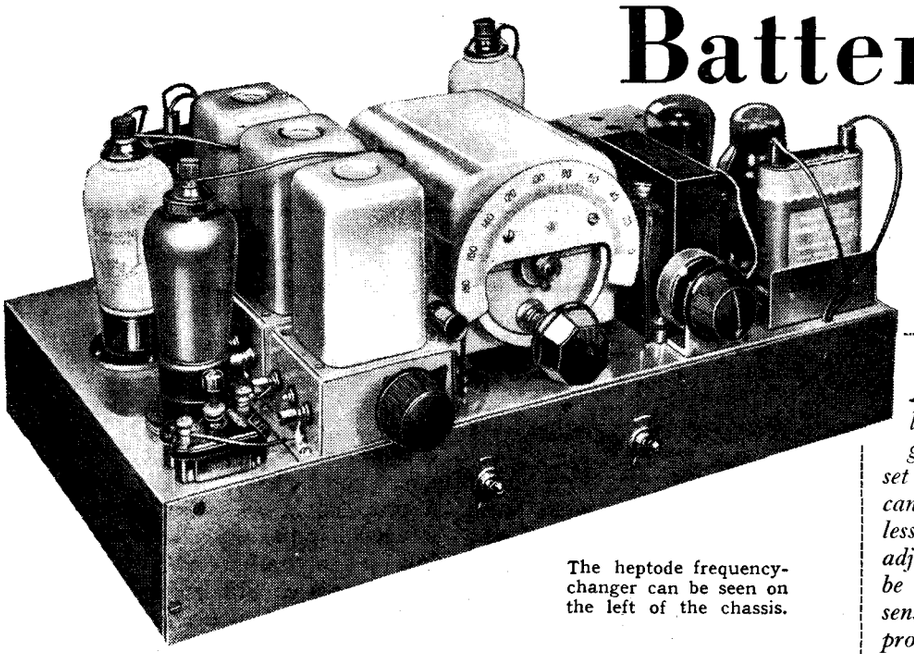
We cannot believe that our present efficient Postmaster-General is going to permit his engineers to continue indefinitely the task of tracing interference if, in the end, he is powerless to enforce the remedies which they prescribe. His past record is proof of his high ideals in the matter of service to the public.

We naturally would wish the I.E.E. Committee to give us the benefit of its deliberations, in order to facilitate the framing of legislation, but we would like to see the Postmaster-General set a time limit, after which the machinery for legislation would be set in motion with or without the assistance of advice from the I.E.E. Committee. We all want to see a satisfactory agreement reached in the electrical industry, so as to smooth the way for legislation, but no possible benefit can result from further delay.

The Everyman Battery Super

A Selective and Economical Receiver with A.V.C.

By W. T. COCKING



The heptode frequency-changer can be seen on the left of the chassis.

ALTHOUGH the chief advantages of the superheterodyne are technical and lie in the improved selectivity which it can give, it is also superior to the straight set in the ease with which high sensitivity can be secured. This ease is reflected in a lessening of the cost and in simplicity of adjustment. A superheterodyne is likely to be cheaper than a straight set of equivalent sensitivity and selectivity, while instability problems are practically non-existent. The Everyman Battery Super is both sensitive and selective and will give high quality reproduction while being economical to operate.

THE greatest changes in receiver technique during recent months have probably occurred in the battery-operated class of set, for it is not long since good quality reproduction and economical operation were as incompatible as fire and water. The advent of quiescent output systems removed at one stroke this major drawback of battery operation, but recent valve developments have led to still further improvements in the performance obtainable. The production of a battery-type heptode has resulted in the saving of a valve, and has also eliminated the difficulties of obtaining accurate ganging in conjunction with satisfactory oscillator coupling inherent in a two-valve system of frequency-changing. The H.F. pentode has led to an increase in the permissible input which can be applied to the H.F. stage of a superheterodyne before overloading occurs, with the result that the possibility of whistle production is reduced.

Furthermore, the increased handling capacity has made it possible to employ a diode-type second detector operating at a large input without distortion being caused by overloading in the I.F. stage. As a secondary consequence of this, A.V.C. can readily be applied, and the use of Westectors instead of valves for these diodes leads to still greater economy of space and material.

The modern battery superheterodyne, therefore, is very different from its predecessors, as can be seen from the complete circuit diagram of the Everyman Battery Super which appears in Fig. 1. It will be seen that the valves are arranged as an H.F. amplifier, a frequency-changer, an I.F. amplifier, a driver stage, and a Class "B" output stage, and that the H.F. valve is preceded by a single tuned circuit.

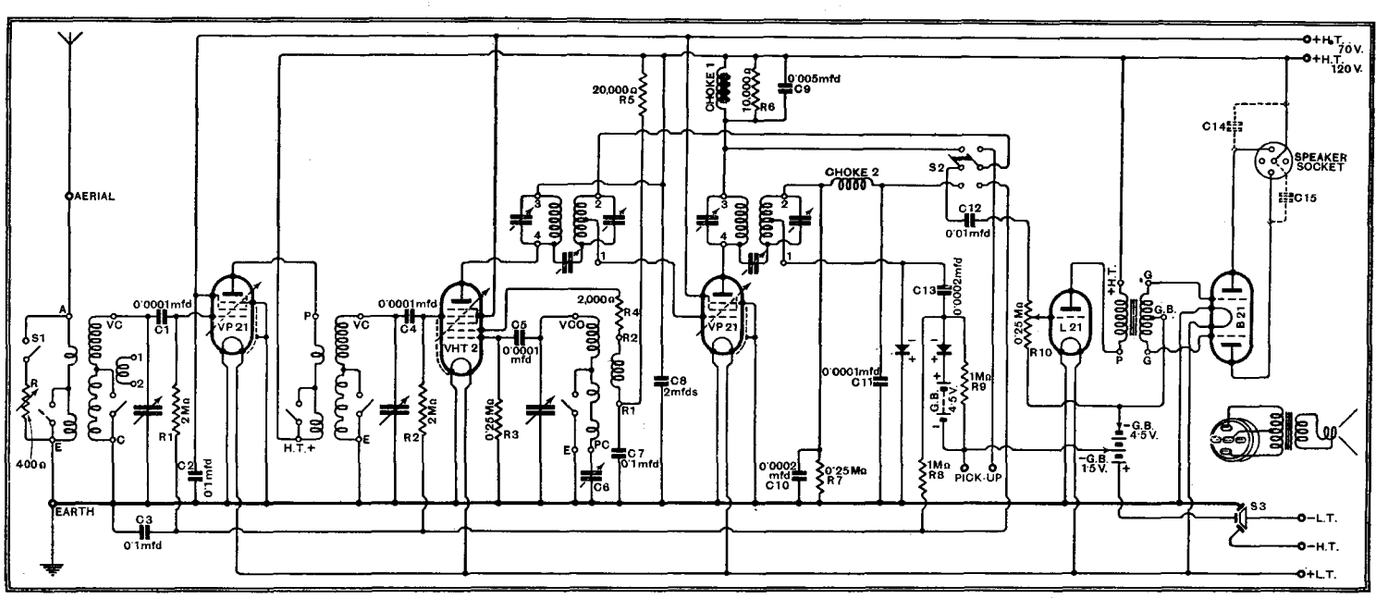


Fig. 1.—The complete circuit diagram of the new superheterodyne in which H.F. pentodes are used for the H.F. and I.F. stages. On gramophone the I.F. valve is used as a first-stage L.F. amplifier.

The Everyman Battery Super—

This valve is coupled to the tetrode portion of the frequency-changer by means of an H.F. transformer, the secondary of which is tuned by the second section of the three-gang condenser. Thus there are two signal-frequency tuned circuits, and as it is the purpose of these to eliminate second channel interference, an efficient type of coil has been selected. Air-cored coils are used in preference to iron-cored types, however, since the degree of sideband cutting obtained is likely to be somewhat less.

In every case the tuning coils and condensers are returned directly to the earth line, which is also the negative L.T. busbar. Bias to the first two valves, therefore, is applied by means of the two 2 megohms grid leaks R1 and R2; while the control grids are isolated by the 0.0001 mfd. condensers C1 and C4.

The oscillator circuit follows conventional practice, and the tuning condenser is of the shaped plate type. A 0.0001 mfd. grid condenser C5 is used with a 250,000 ohms grid leak R3, and a 2,000 ohms resistance R4 is inserted in series with the reaction coil in order to maintain more even oscillation over the waveband. The oscillator anode is fed from the H.T. line through the 20,000 ohms resistance R5 with a 0.1 mfd. by-pass condenser C7.

The Second Detector

The primary of the first I.F. transformer is connected in the tetrode anode circuit of the frequency-changer valve, and the control grid of the H.F. pentode, which acts as the I.F. stage, is fed from a tapping on its secondary. On radio, the lower end of this tuned circuit is joined with the two grid leaks R1 and R2 to the A.V.C. line, so that all three of the pre-detector stages are controlled for A.V.C. purposes. The primary of another I.F. transformer is connected in the anode circuit of this valve, and its secondary is also tapped and feeds the second detector and A.V.C. system.

One Westector acts as the second detector and is used with a 250,000 ohms load resistance R7, while the I.F. currents are filtered out by the choke Ch2 in conjunction with the two condensers C10 and C11. The L.F. output is taken through the 0.01 mfd. condenser C12 to the grid of the driver valve, volume control being obtained by means of the 250,000 ohms potentiometer R10.

A second Westector is fed in parallel with the first through the 0.0002 mfd. condenser C13, and the 1 megohm resistance R9 acts as its load. In order to obtain delayed A.V.C., this Westector is biased by a $4\frac{1}{2}$ volts battery, so that it is inoperative until the detector input exceeds $4\frac{1}{2}$ volts peak. For larger inputs a bias voltage is developed across the resistance R9, and this is applied to the controlled valves through the filter comprising R8 of 1 megohm and C3 of 0.1 mfd.

A 1 : 1 ratio driver transformer is connected in the anode circuit of the driver valve, which is normally of the L.21 type, and its secondary feeds the B.21 Class "B" valve. The output transformer, which is, of course, connected in the anode circuit of this valve, is mounted on the loud speaker.

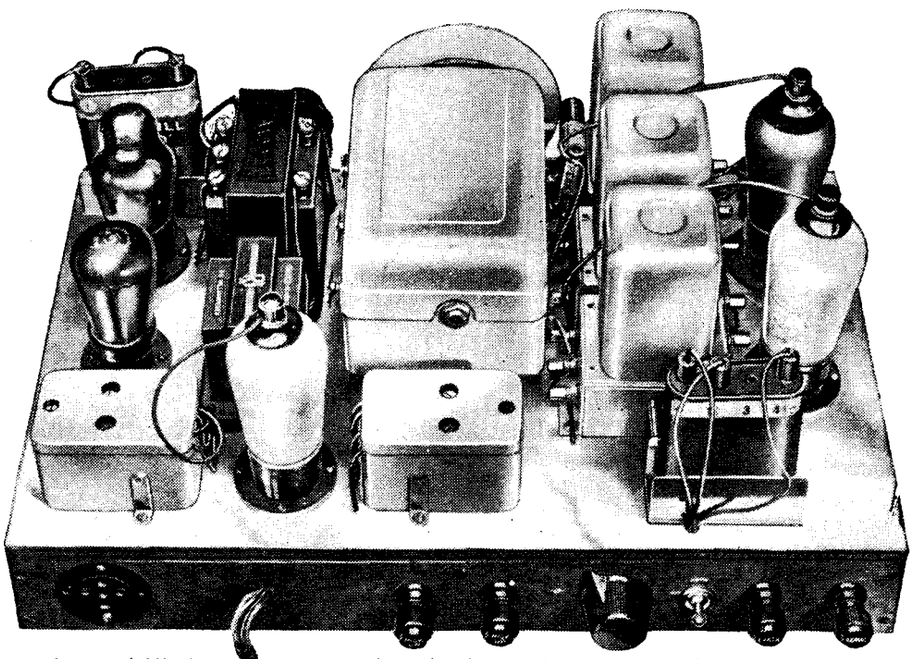
On gramophone, the amplification of the driver valve alone is insufficient for reasonable volume, and so the I.F. valve is connected to a first stage L.F. amplifier. An L.F. coupling, consisting of the choke Ch1, the 10,000 ohms resistance R6, and the 0.005 mfd. condenser C9, all in parallel, is connected in its anode circuit, and the radio-gramophone switch S2 changes over the input connections of the driver valve from the detector output to the anode circuit of this valve. This switch also changes over the grid return lead from the A.V.C. line to a fixed bias and inserts the pick-up. The manual volume control functions on both radio and gramophone.

The receiver is intended to operate normally from a 120 volts H.T. supply and with about 70 volts applied to the screen grids of the first three valves. Under these conditions $4\frac{1}{2}$ volts bias is applied to both Class "B" and driver valves and a minimum of $1\frac{1}{2}$ volts to the others. The total anode current consumption with no signal is then about 14 mA. On tuning in an unmodulated carrier, the current falls, owing to the increased bias on the early valves as a result of automatic volume control. When the station modulates, however, the current is increased, due to the characteristics of the Class "B" valve. The no-signal anode current, therefore, is little guide to the average current over a long period, which is the true figure upon which the life of the battery depends. It may truly be said, however, that the stronger the carrier to which the receiver is tuned, and the lower the volume at which the set is worked, the smaller will be the average current consumption. It is recommended, however, that the H.T. battery be of at least medium capacity in order to secure a reasonably long life. The total filament current consumption is 0.6 ampere at 2 volts, so that a moderately large capacity accumulator should be used; 20 a.h. to 30 a.h. should be entirely satisfactory.

The Delay Voltage

The value of the delay voltage selected for the A.V.C. system requires some comment. It has been found experimentally that $4\frac{1}{2}$ volts is the best for average conditions, but this does not mean that it is necessarily the best for all. If a lower voltage be used, A.V.C. will come into operation on weaker signals, with the result that the volume will be less than it would be with the normal delay voltage. A.V.C. will smooth out fading to a somewhat greater extent, however. If we go to the other extreme, and use a higher delay voltage than the normal of $4\frac{1}{2}$ volts, the volume of some stations may be increased, but A.V.C. may do little to counteract fading. The delay voltage, therefore, should be selected experimentally for the best performance. If a good aerial be used, one can afford to use a smaller delay voltage and obtain better smoothing of fading than if the aerial is inefficient and the full sensitivity of the set is required for good volume. It will be found that the value of delay voltage used makes a noticeable difference only on signals of moderate strength. On weak signals and on very strong signals there will be little, if any, audible effect of making a change.

Whatever delay voltage be used, however, A.V.C. cannot give adequate control



An "aerial" view of the receiver chassis, showing the layout of components. The driver transformer can be seen on the left close to the output valve.

The Everyman Battery Super—

of a powerful local station, for overloading occurs in the early valves. A "Local-Distance" switch is necessary, therefore, and this takes the form of a resistance R, which can be connected at will between the aerial and earth terminals by means of the switch S1. Since the precise value of resistance necessary for the avoidance of distortion naturally varies in different localities and according to the efficiency of the aerial system employed, the resistance R is made variable and it can readily be adjusted to suit any likely practical conditions. In order to avoid long leads in the H.F. circuits, both R and S1 are mounted at the rear of the chassis, and it is not recommended that their positions be altered. The assembly of the components, wiring up, and initial testing will be dealt with in next week's issue.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 Gang Condenser, superhet, with cover and "A" drive **J.B. No. 2101 Type "F"**
(Polar, Utility)
1 Superhet Aerial Coil **Wearite Type W.S.A.**
1 Superhet H.F. Transformer **Wearite Type W.S.H.F.**
1 Superhet Oscillator Coil **Wearite Type W.S.O.**
2 Ferrocart Colverdynes, 110 kc/s **Colvern**
(Varley)
1 Screened H.F. choke, Ch2 **Wearite HFP**
(Bulgin, Kinva)
1 Fixed Condenser, 2 mfds. 750 volts D.C. test, C8 **Peak A3**
3 Fixed Condensers, tubular, 0.1 mfd. 750 volts D.C. test, C2, C3, C7 **Peak Type "M"**
1 Fixed Condenser, tubular, 0.01 mfd. 750 volts D.C. test, C12 **Peak Type "M"**
1 Fixed Condenser, tubular, 0.005 mfd. 750 volts D.C. test, C9 **Peak Type "M"**
4 Fixed Condensers, tubular, 0.0001 mfd. 750 volts D.C. test, C1, C4, C5, C11 **Peak Type "M"**
2 Fixed Condensers, tubular, 0.0002 mfd. 750 volts D.C. test, C10, C13 **Peak Type "M"**
(Dubilier, Graham-Farish, T.C.C., T.M.C.Hydra, Telsen)
1 Pre-set Condenser, 0.002 mfd., C6 **R.I "Varicap"**
1 Driver Transformer, 1 to 1 **Ferranti AF17c**
(Multitone, R.I., Varley)
1 L.F. Choke, Ch1 **R.I. "Hypercore" DY22**
1 Resistance, 2,000 ohms, R4 **Graham-Farish "Ohmite"**
1 Resistance, 10,000 ohms, R6 **Graham-Farish "Ohmite"**
1 Resistance, 20,000 ohms, R5 **Graham-Farish "Ohmite"**
2 Resistances, 250,000 ohms, R3, R7 **Graham-Farish "Ohmite"**
2 Resistances, 1 megohm, R8, R9 **Graham-Farish "Ohmite"**
2 Resistances, 2 megohms, R1, R2 **Graham-Farish "Ohmite"**
(Dubilier, Erie, Claude Lyons, Scradex, Watmel)
1 Tapered Volume Control, 250,000 ohms and knob, R10 **Claude Lyons 250 M-T**
(Magnum, Rothermel, Watmel)
1 Wire-wound Potentiometer, 400 ohms, R **Wearite Q13**
1 S.P. On-off Toggle Switch, S1 **Bulgin S80T**
(Claude Lyons)
1 D.P.D.T. Toggle Switch, S2 **Bulgin S.98**
1 4-point Toggle Switch, S3 **Bulgin S.87A**
2 5-pin Valve Holders **Clix Chassis Mounting Standard Type**
4 7-pin Valve Holders **Clix Chassis Mounting Type**
(Ferranti, W.B.)
2 Westectors **Westinghouse W.4**
2 G.B. Batteries, 4½ volts
2 G.B. Battery Clips **Gripso**
(Bulgin)
1 5-way Battery Cable, 30in., with wander plugs and spade ends **Belling-Lee**
(Bulgin, Goltone)
5 Wander Plugs **Clix Type "B"**
(Belling-Lee)
4 Terminals, A., E., Pick-up (2) **Belling-Lee Type "B"**
1 5-way Connector **Wilburn**
1 5-pin Plug **Bulgin P.3**
(British Radio Gramophone Co.)
Plymax Baseboard, 9½in. x 16in. x ⅜in. **Peto-Scott**
1 Bracket for volume control **Peto-Scott**
1 Bracket for H.F. choke **Peto-Scott**
2oz. No. 20 tinned copper wire, 6 lengths Systoflex, wood, wire, etc.

Screws:—
2 1in. No. 4 R/hd.; 2 ⅜in. No. 6 R/hd.;
6 ⅜in. No. 4 R/hd.; 10 ⅜in. No. 4 C/sk.;
12 ⅜in. No. 4 R/hd.; 30 ¼in. No. 4 R/hd.

Loud Speaker. Rola Type FR6-PM23 for B21 Valve or W.B. Type PM4A.

Valves:—2 Marconi or Osram VP21, 1 Ferranti VHT2, 1 Marconi or Osram L21, 1 Marconi or Osram B21.

A Real Wireless Orchestra

New Musical Instruments for the Microphone

IS it economical, to say the least, to employ an orchestra of a hundred or more players to produce a result which must be narrowed down to the frequency and tonal limitations of the domestic loud speaker? This question has exercised the imagination of M. Ernest Sarnette, of the Paris Ecole Superieure de Musique, and he has attempted to answer it in a practical manner by inventing new musical instruments. In an interview with a correspondent of *The Wireless World* M. Sarnette described the newcomers, which are all wind instruments.

According to M. Sarnette, the instruments bring "a new colour, with bass notes which are pure and powerful without being noisy." He explained that he had no intention of replacing the classic symphony orchestra; his idea has been to provide on occasion suitable "understudies." For instance, a number of instruments can be replaced in the broadcasting or film studio by the contra bass clarinet and the tuba without any alteration of musical scores. Indeed, he believes that with the development of a special school of music for the microphone wind instruments will come into their own.

New valve trombones in action. They are fitted with six pistons.

On the left is the new contra bass clarinet, designed to replace the 'cellos and double basses in a microphone orchestra. The microphone tuba is on the right.

The principal instruments of the new Sarnette group are shown in the illustrations. M. Sarnette is seen in the centre of the lower picture. On the left is the new contra bass clarinet, which is designed to replace the 'cellos or double basses in a microphone orchestra. Its tone is described as very sweet and powerful. On the right is the new microphone tuba, which must not be confounded with its prototype, for this instrument wanders far above the ordinary bass compass. Note the movable bell, which can be oriented towards the microphone. In the upper picture is the new valve trombone with six pistons and its bell specially directed towards the microphone.

Our correspondent asked M. Sarnette whether he had been reproached for suppressing the violin.

"My reply," said M. Sarnette, "is that I regard the violin simply as a solo instrument. A large number of violins produce a timbre which can be replaced easily and inexpensively, particularly in the case of the microphone orchestra.

"For more than a century it has been dinned into the ears of the people that the tone colour of the violin is superior to all else in its emotional quality. To-day it is my impression that when the violin executes a so-called enchanting or tearful melody there is an entire absence of any effect of novelty, and there are already signs that the public ear is growing weary.

"I believe in creating a new type of orchestra for wireless performance. Judging from my experience of recording music on film it is possible with, say, fourteen players to obtain better results than those obtained by a notable European orchestra of fifty musicians. It is my feeling that the classic symphony orchestra has its place on the concert platform, but not before the microphone."

BOOKS RECEIVED

The Physics of Electron Tubes, by L. R. Koller, Ph.D. The fundamental physical phenomena involved in the operation of Electron Tubes, including the Theory of Thermionic Emission, Emission from Various Metals, "Getters" and clean-up of Gases, Space Charge, Discharges in Gases, Grid-controlled Arcs, Photo-electricity, Photo-conductivity, etc. Pp. 205, with 66 diagrams and illustrations. Published by McGraw-Hill Book Co., Inc., New York, and McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 18s.

Die Kathodenstrahlröhre und ihre Anwendung in der Schwachstromtechnik, by Manfred von Ardenne. The use of the cathode ray tube in high-frequency work and television. Pp. 398+viii, with 432 illustrations and diagrams. Published by Julius Springer, Berlin. Price R.M.36.

When Current Flows....

Explaining and Calculating Voltage Drop

By S. O. PEARSON, B.Sc., A.M.I.E.E.

ONE of the first things to be learnt in connection with the flow of electric currents in conductors or circuits is Ohm's law, and it is soon found, even by the beginner, how easy this law really is to understand. It tells us that if the voltage applied to a simple resistance is doubled, the current will be doubled also; in other words, that the current is directly proportional to the applied voltage.

But although it is so easy to apply Ohm's law to a simple resistance in this way, many apparent difficulties arise when we come to deal with practical circuits, even of a simple nature. We find, for instance, that in some circumstances *electromotive force* (E.M.F.) is referred to; in others we have to contend with *potential difference* (P.D.) and sometimes *voltage drop* or *potential drop*, all of these quantities being expressed in volts. But in spite of the fact that all three of them are expressed in the same units, their meanings are quite different, and it is usually due to an inadequate understanding of their meanings that difficulties occur.

The present article is intended to assist those who have experienced difficulty in grasping the fundamental laws of elementary circuits by giving simplified explanations of the principles involved, and by the working out of practical examples.

Current and the Ampere

There is a great deal to be gained from the study of such a simple circuit as a piece of resistance wire connected across the terminals of a battery as shown in

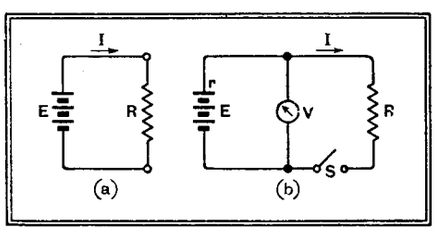


Fig. 1.—Simple circuits for explaining the nature and cause of voltage drop.

Fig. 1 (a). It is common knowledge that a current of electricity will flow round the circuit and that the resistance wire will be heated by the current. Now, a current of electricity is regarded as a stream of electrons, or minute charges of electricity, moving round the circuit and through the resistance wire, just as a current of water in a river is a stream or drift of water molecules.

The value of the current is gauged in terms of one of its more important physical effects, namely, the property of depositing metal by the process used in electro-plating. The practical unit is the *ampere*, which is defined internationally as the value of the constant current which deposits 0.001118 gram of silver per second. It is a rigid law that the mass of metal deposited per second is exactly proportional to the current.

Resistance

As the electrons representing the current in the circuit of Fig. 1 (a) pass from atom to atom on their way through the wire they experience an opposition to their motion—they have to be forced through—and this opposition is due to what may be regarded as a kind of frictional resistance to the passage of electrons through the wire and which is the property known as electrical *resistance*. The amount of resistance offered by a conductor depends on its dimensions and on the material from which it is made (also to a relatively small extent on the temperature). Resistance is usually measured in *ohms*, the ohm being defined internationally as the resistance of a uniform column of pure mercury of specified dimensions at the temperature of melting ice.

> *"THE main output terminals of my H.T. eliminator are marked 150 volts; why cannot I rely on obtaining exactly that voltage, or at any rate something approximating fairly closely to it under all conditions, irrespective of the working load?"*
>
> *Here is the answer to this and many other similar problems which are apt to puzzle the beginner. The absolute interdependence of voltage and current is discussed in a particularly helpful manner.*

To start and maintain the current or stream of electrons through the resistance wire of Fig. 1 (a) it is clear that a driving force of some description is required. This is called an *electromotive force* or E.M.F., because it exerts its influence on electrons. In this case the battery furnishes the necessary E.M.F., which is generated by electro-chemical action inside the cells of the battery. E.M.F. can also be produced by electromagnetic means as in a dynamo or generator.

The magnitude of the electromotive force engaged in driving the current round a closed circuit like that of Fig. 1 (a) depends on (1) the value of the current and (2) the resistance of the conductors comprising the circuit. Ohm's law tells us precisely what the relationship between these three quantities is. It states that

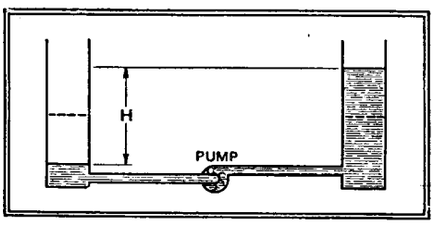


Fig. 2.—Water-pump and tank system analogous to a battery on open circuit.

the E.M.F. required to drive a current round the circuit is exactly proportional to the strength of the current and to the resistance of the circuit. Knowing the definitions of the ampere and the ohm we can now make use of Ohm's law in defining the practical unit of E.M.F., namely, the *volt*. One volt is the value of the electromotive force required to drive one ampere of current through one ohm of resistance.

We shall assume in the first instance that the battery in Fig. 1 (a) is itself quite devoid of resistance. If R is the resistance connected across the terminals of the battery in ohms and I is the current in amperes, the electromotive force must be, by Ohm's law, $E = I \times R$ volts.

It should be realised that the E.M.F. of a battery or accumulator is a constant quantity depending only on the composition of the battery. Whether it is driving a current through an external circuit or not, its internal E.M.F. is the same. Another fact to be noted is that the E.M.F. is *wholly internal* and cannot be measured directly. When the battery is on open circuit it *tends* to drive a current, but, as there is no circuit, it cannot, and this effort has a definite effect which we shall consider next.

An analogy will be helpful here. Imagine a rotary centrifugal water pump connected between two tanks as in Fig. 2. Before the pump is started the water in the two tanks will be at the same level. Now suppose that the pump is driven at a constant speed so that it exerts a *constant* hydraulic pressure; water will be transferred from one tank to the other, and the increasing difference in the levels will result in a back pressure tending to drive the water back again through the pump. The difference in levels will continue

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to increase until the resulting back pressure becomes exactly equal and opposite to the force generated by the pump. After this there will be no further flow of water, and the back pressure, which can be expressed in terms of the difference in the levels or head H, is an exact measure of the internal force exerted by the water-pump.

In the same way the internal E.M.F. of a battery on open circuit transfers electrons from one pole or terminal to the other, setting up a difference of electrical level between the terminals. An electrical back pressure is built up tending to drive the electrons back through the battery to their original positions. This difference of electrical level is called *potential difference* (P.D.), or *voltage* when expressed in volts. When the battery is on open circuit the P.D. between the terminals is exactly equal and opposite to the internal E.M.F. So when a very high-resistance voltmeter is connected across the terminals of the battery it gives a reading numerically equal to the E.M.F., provided no current is flowing. (In general, when a voltmeter is connected between any two points in a circuit it measures the potential difference between those two points.)

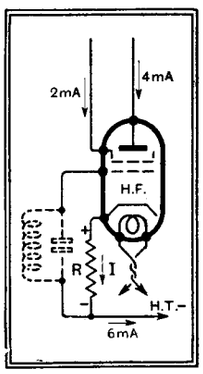

Fig. 3.—Showing how the volt drop in the cathode resistance is used for producing negative grid bias in a mains valve.

Voltage Drop

In applying Ohm's law to the simple circuit of Fig. 1 (a) it was assumed that the battery itself contained no resistance. But in practice the battery is bound to possess resistance, so now let us consider the more practical case, assuming that the battery has a resistance of r ohms.

The circuit under consideration is shown in Fig. 1 (b), a voltmeter V being connected permanently across the battery terminals. The voltmeter is assumed to have an infinitely high resistance so that it takes no current (being electrostatic). A switch S enables the load resistance to be put in or out of circuit at will. With S open the voltmeter gives a reading equal to the E.M.F. of the battery, which we shall denote by E as before. When S is closed the current flowing round the circuit is given by dividing the E.M.F. by the *total* resistance, which is $R+r$ ohms. As a numerical example, suppose that our battery is a 6-volt accumulator with an internal resistance of 0.2 ohm. Let the external or load resistance R be 3 ohms. Then the total resistance in the circuit is 3.2 ohms, and the current is $I=\frac{6}{3.2}=$ 1.875 amperes.

We see then that when the 3-ohm resistance is connected across the 6-volt battery the current is not 2 amperes, as might at first be expected, but somewhat less. The reason is that *a portion of the E.M.F. of the battery is absorbed in driving the current through the resistance of the battery itself.* It follows from this that the actual voltage applied to the external load resistance is less than 6 volts, its value being indicated by the voltmeter. It can be calculated quite easily by applying Ohm's law to the external resistance only, namely, $V=IR=1{,}875\times 3=5.625$ volts. This is the voltage at the terminals of the battery when the current is flowing, and it should be noted that it is 0.375 volt *less* than the 6 volts E.M.F. of the battery. Obviously there is a *voltage drop* in the battery itself due to the internal resistance. This drop in voltage at the terminals is equal to the product of the current through the battery and the internal resistance. In this case it is $I\,r=1.875\times 0.2=0.375$ volt, as already found by subtracting the terminal voltage from the E.M.F.

Voltage drop occurs in all electrical apparatus where current flows through resistance, and it is always given by the product of current and resistance. Sometimes it is a necessary evil, as at the terminals of a battery or eliminator, where it causes a change in terminal voltage every time the load current varies.

Making Use of Volt Drop

On the other hand, the voltage drop across a simple resistance can often be put to useful purpose, particularly in connection with radio receiving circuits. For instance, in receivers where self-bias is provided for the grids of the various valves, the necessary bias voltages are actually the potential differences set up across resistances connected in suitable positions in the circuit. As an example, suppose that an indirectly heated screen-grid valve is to be operated with a negative grid bias of 3 volts, and that, under operating conditions, the steady anode current is 4 milliamps. and the screen current 2 mA. The total current in the cathode lead will then be 6 milliamps.

If a resistance R is connected in the cathode lead, as shown in Fig. 3, the current I flowing through this resistance will cause a voltage drop of IR volts across R, the end joined to the −H.T. lead being negative with respect to the end joined to the cathode. The grid, being electrically connected to the negative end of R, is biased negatively with respect to the cathode by IR volts. In this case IR is to be 3 volts when I=6 mA. (0.006 ampere), and so $0.006.I=3$, or $I=\frac{3}{0.006}=\frac{3000}{6}=$ 500 ohms.

When we come to consider the voltage drop at the terminals of an A.C. eliminator, the matter is somewhat more complicated. It is often noted, perhaps with some surprise at first, that when the eliminator is supplying no load, the voltage at the D.C. output terminals is considerably greater than the secondary terminal voltage of the input transformer, as indicated on an A.C. voltmeter. The reason for this is that on the input side of the rectifier we are dealing with an *alternating* voltage; that is, one which reverses its direction periodically and which reaches a maximum or peak value in either direction considerably in excess of the "effective value" which the voltmeter indicates.

Eliminator Voltage and Load

To obtain a clear understanding of the nature of the voltage drop in an A.C. eliminator, it is necessary to know just what is meant by "effective value" or "R.M.S. value" of an alternating quantity. We know that, although an alternating voltage or current is reversing its direction many times per second, an ammeter or voltmeter in an A.C. circuit gives a steady reading as though it were in a D.C. circuit. As a matter of fact, the *effective value* of an alternating current is defined as the value of the direct current which has the same average heating effect when flowing through a given fixed resistance. Similarly, the effective value of an alternating voltage is the value of the steady direct voltage which would produce the same average heating effect when applied to a given fixed resistance. For reasons connected with the mathematical calculation of effective value in terms of the successive instantaneous values of an alternating quantity, the effective value is commonly referred to as the Root Mean Square (R.M.S.) value.

An alternating current or voltage, when plotted as a graph against time, gives a wave which repeats itself as time elapses, and the simplest wave-shape is that of a sine wave, as shown in Fig. 4. The simple sine law is very closely followed by the voltages of electric supply mains.

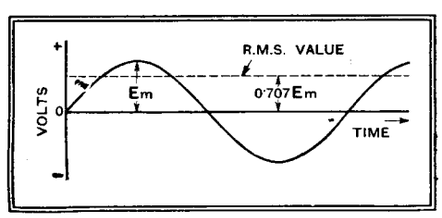

Fig. 4.—Sine wave of alternating voltage. The R.M.S. value, E, is 0.707 of the maximum or peak value, Em.

It can be shown that an alternating current obeying the sine law and fluctuating between maximum values of one ampere in either direction is equivalent in its heating effect on a given resistance to a direct current of 0.707 ampere. That is to say, *the effective or R.M.S. value is* 0.707 *of the maximum or peak value;* and similarly for voltages. From this it follows that the peak value of an alternating voltage is $\frac{1}{0.707}$ or 1.414 times as great as the R.M.S. value indicated by the voltmeter.

Now let us consider a typical A.C. eliminator required to give 50 mA. D.C. at

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200 volts, employing full-wave rectification. The circuit arrangement is shown in Fig. 5, a 640-ohm choke being used in the smoothing circuit. It will be assumed that the effective anode-to-cathode resistance *on each side* of the full-wave rectifier valve is 1,000 ohms, and that the object in view is to estimate the R.M.S. voltage required on each side of the centre-tapped secondary winding of the mains transformer.

The first step is to calculate the total voltage drop. In the choke the volt drop

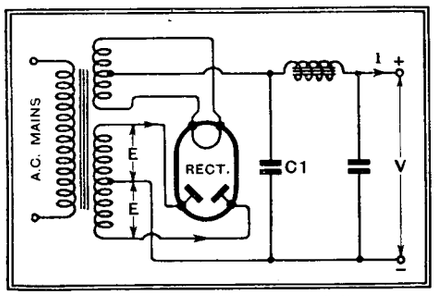


Fig. 5.—A.C. eliminator with full-wave rectification.

is simply the product of current and resistance in that part, namely, $0.05 \times 640 = 32$ volts. But a little more care is needed in estimating the volt drop in the rectifying valve itself. It will be realised that the current enters the valve in two equal parts *via* the anodes, not as smooth currents but as pulsations, and *these pulsations do not occur simultaneously but alternately*. So the total current is, in effect, switched alternately through one or other of the two 1,000-ohm anode-to-filament resistances, and for this reason the equivalent resistance of the valve as a whole is the same as that of either of the alternate paths, namely, 1,000 ohms. The volt drop is therefore $0.05 \times 1{,}000 = 50$ volts, and the total voltage drop in the rectifier and smoothing choke combined is $50 + 32 = 82$ volts.

This means that the no-load voltage at the output terminals must be 282 volts, neglecting any small voltage drop which may occur in the transformer itself. Since there is no volt drop anywhere with no current, the voltage across the reservoir condenser C_1 will also be 282 volts. Now, with no current flowing, this condenser is charged to a voltage practically equal to the peak value Em (see Fig. 4) of the alternating voltage applied to the valve; so the *peak* value of each half of the transformer secondary voltage must be about 282. The required R.M.S. value is 0.707 of this, namely, $E = 0.707 \times 282 = 200$ volts. Since we have neglected volt drop in the transformer it follows that this is the *full load secondary voltage* on each side of the centre tap.

If we allow for a 5 per cent. rise in the transformer secondary voltage when the full load is switched off, the actual no-load voltage at the output terminals of the eliminator would be 5 per cent. greater than the 282 volts previously estimated, being now 296 volts. It will be noted that this is considerably greater than the R.M.S. voltage input to the eliminator.

DISTANT RECEPTION NOTES

"Snakes and Ladders" on the Medium Waveband

NEWS of several important increases in output power has just reached me from the United States. WBZ, of Springfield, Massachusetts, which works on 302.8 metres, has gone up from 25 to 50 kilowatts; WHAM, of Rochester, New York, with a wavelength of 260.7 metres, from 25 kilowatts to 50; KVOO, of Tulsa, Oklahoma, from 5 kilowatts to 25. Both WBZ and WHAM were well heard in this country as 25-kilowatt stations, though I never remember seeing the 5-kilowatt KVOO reported and I have not logged it myself. Now that KVOO is working with 25 kilowatts it is definitely worth trying for.

It is probable that if the Eiffel Tower does not close down it will eventually share one of the French common wavelengths. Paris can hardly expect another individual channel, since it already has Radio-Paris, Paris PTT, Radio LL, and the Poste Parisien. Moscow is the only European city that can compete with Paris in the number of its broadcasting stations.

The U.I.R. report for the latter half of January is particularly interesting, for it shows how stations behaved themselves during the first fortnight of the Lucerne Plan's history. The only stations which have a perfectly clean record are Athlone, Vienna, Sundsvall, Florence, Prague, Langenberg, Söttens, Munich, Leipzig, Milan, Berlin, Hamburg, Göteborg, Breslau, Genoa, Hörby, London and West Nationals, Copenhagen and Nürnberg, with Bournemouth and Plymouth, which share a wave between them.

Since not a few of the crystal or tuning-fork controlled stations in this and other countries showed appreciable deviations from their allotted frequencies, one may wonder whether the limits set by the Lucerne Plan—50 cycles for stations with individual channels and 10 cycles for stations using certain common wavelengths—are not too narrow to be carried into effect.

Some stations clearly made no attempt at all to work the Plan. The errings and strayings of Fécamp, Radio Lyons, Juan-les-Pins and Fredriksstad are reminiscent of the old game of "Snakes and Ladders." Most of the Spanish stations appear to have made attempts, though not very successful ones, to hit the proper wavelengths. Few of them were able to keep within *plus* or *minus* 2 kilocycles! Several of the Russians were very badly out, the worst offenders being Arcangel, Astrakhan and Ivanovo.

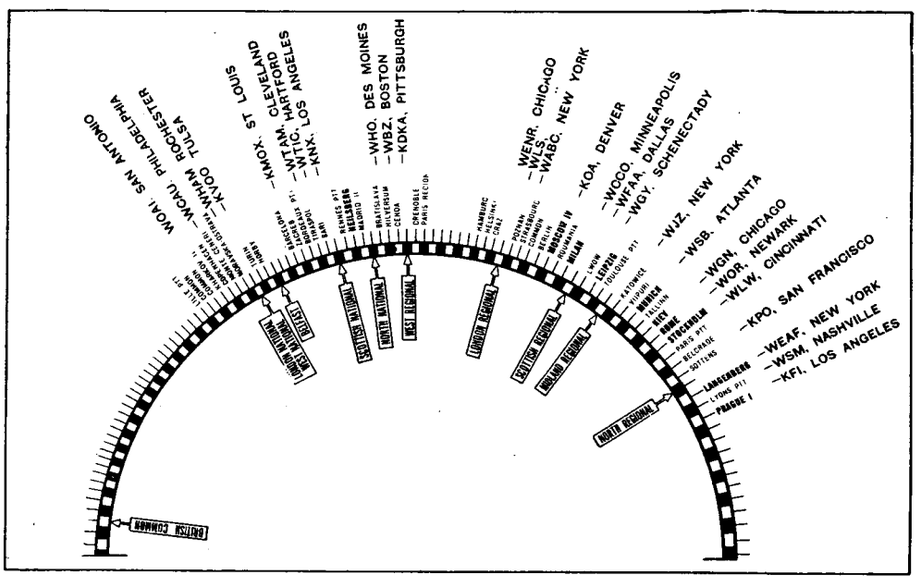
Illicit Transmissions

Some time ago I mentioned that unauthorised transmissions might be something of a problem unless they could be tracked down and suppressed. On the medium waveband alone the U.I.R. report shows over a score of unnamed transmissions. Nearly all of these must be illicit, for the personnel of the Brussels checking station is so practised that it can identify any authorised station almost instantly.

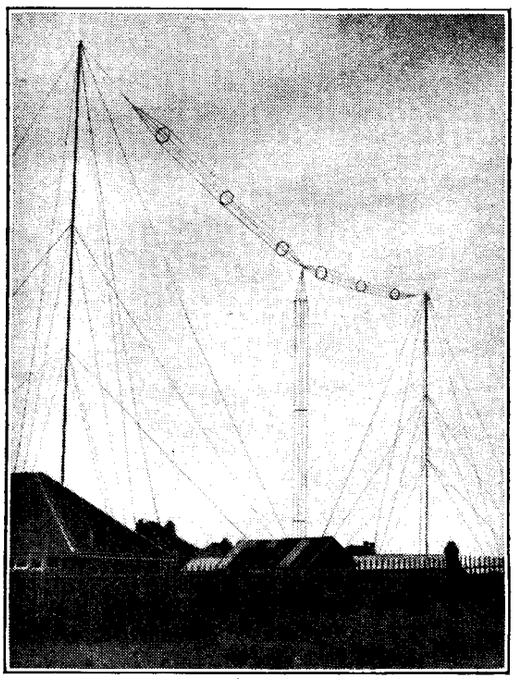
The position on the medium waveband appears to be clearing up satisfactorily. On the long waves, too, good reception is now the rule from Huizen, Zeesen, Warsaw, Motala, Luxembourg, Kalundborg and Oslo. Radio-Paris is becoming less seriously interfered with, and on certain days it is quite clear.

Budapest, Beromünster, Athlone, Stuttgart, Vienna, Florence, Brussels No. 1, Prague, Lyons PTT, Langenberg and Söttens are excellent near the top of the medium waveband, and rather lower down good reception can be relied upon from Paris PTT, Stockholm, Rome, Munich, Brussels No. 2, Breslau, Bordeaux and Frankfurt. I am glad to be able to report that Leipzig, which had been heterodyned without intermission since the coming of the Lucerne Plan, has been clear of interference for some days prior to the time of writing, and that Hilversum is now also well received after a bad period of heterodyning.

D. EXER.



TUNING IN THE AMERICANS. The diagram indicates where some of the more powerful U.S. transmitters may be located on the tuning dial.



OUT OF THE PAST. A glimpse of the aerials at the old Bournemouth transmitter.

IS HIGH POWER

A Plea for Better Control of Output

By R. W. HALLOWS, M.A.

NO one can deny that high power has brought several important benefits in its train, but there must be many who are beginning to wonder whether the gains on the swings are not more than offset by the losses on the roundabouts. This country was the first to put forward a high-power regional scheme. The ideas foremost in the minds of those responsible for it were that it would mean a considerable enlargement of service areas and that better reception would result from the more favourable signal-to-noise ratio that appeared certain to obtain.

Service areas have certainly become bigger, and high power might well have solved the signal-to-noise problem had we been the only country in Europe to adopt it. But already a large number of the medium-wave and long-wave channels are occupied by high-power stations, and before long every one of them, with the exception of those earmarked as national or international common waves, will have its giant transmitter, the majority working with power outputs considerably in excess of those of our home stations. Interference between stations is nowadays a very much more acute problem than it was before the coming of high power.

It was prophesied of our own regional scheme that high-power transmissions would inaugurate a new and brighter era for the listener. Fidelity in reproduction would be easier to obtain, receiving sets would be smaller and simpler; their installation and their maintenance would involve less expense. It can scarcely be claimed that this forecast has been borne out in fact. We might almost say, borrowing the words of the legendary Irishman, that it was absolutely correct except that everything was just the opposite!

In the days when there was hardly a station in Europe with an output rating greater than some 4 kilowatts such things as cross modulation, detector overload, "break-through" from medium to long waves and sideband splash were unknown. But no sooner had the London Regional and the London National got under way when these began to present some very pretty problems to the set designer and the set user. Cross-modulation and break-through have proved amenable to treatment, though they have necessitated the development of special valves, special circuits and special components. The cure of detector overload is mainly a matter of design, but that does not help the old set. Sideband splash still remains an unsolved and, in the light of our present knowledge, apparently an insoluble problem.

Then selectivity. Receiving sets which were previously satisfactory were found at once to be unable to cope with the new state of affairs. Even when only two of the regional stations were at work many of them were so completely swamped that they could not separate the twin transmissions. Others succeeded in doing so, but could bring in nothing else. A tuned high-frequency stage or a band-pass filter or both became essential. The receiving set became immediately more complicated and relatively more expensive.

I write "relatively" because mass production methods have enabled prices to be reduced year after year. Prices would have been far lower could receiving sets have remained simple.

High Power Continentals

When foreign countries evolved high-power schemes and brought them into being the difficulty of reception increased by leaps and bounds. Selectivity of a high order became more and more necessary. On this account sets that had been satisfactory performers in the previous season were found year after year out of date when autumn came round once more. The two-valve set had its day, but it was forced to give way to the more selective three-valve. For some time the latter was able to hold its ground through a constant improvement in its selectivity. It remained for some time the most popular of receiving sets, but now it is fighting a losing battle. The superheterodyne, with its greater number of valves and its far sharper tuning, is rapidly ousting it.

High-power broadcasting has had also another curious result which is the direct opposite of what was foreseen: to be able to receive an equal number of home and foreign stations the wireless set of to-day must be a good deal more sensitive than that of seven or eight years ago. This is the unexpected with a vengeance! But any old hand at long-distance work who turns back the pages of his log can hardly fail to agree that it is so.

Low Power Stations Easily Received

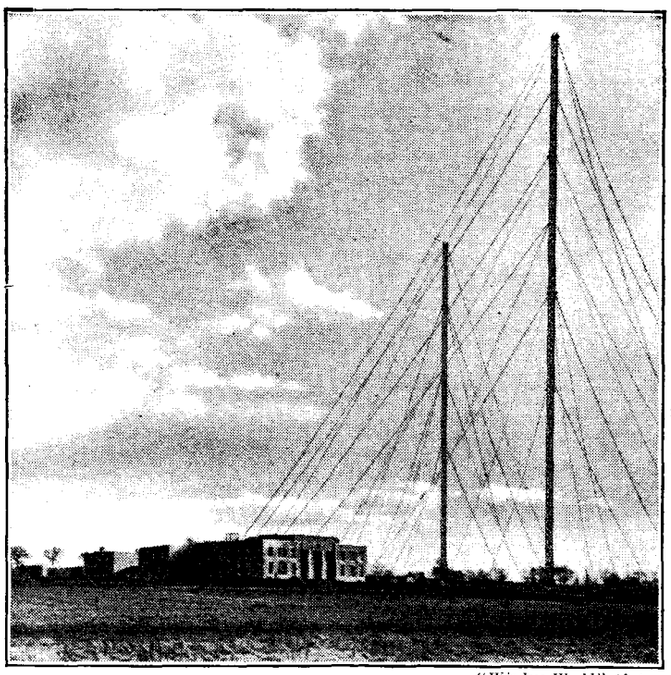
In those days, which now seem to be so far away, I used as a rule a three-valve set containing a high-frequency stage, a detector and an output stage. Sometimes a second low-frequency stage was employed. With this simple equipment stations in all parts of Europe with power output ratings between 0.5 kilowatt and 4 kilowatts were regularly received at full loud speaker strength. It was no uncommon event to receive in the same way the 200-watt Swedish relays or the low-powered home relay stations such as Plymouth, Swansea or Dundee.

I do not believe that equally good results could be obtained with *any* receiving set nowadays, but to come near them a superheterodyne with a minimum of six or seven valves would be required. The reason, probably, is that the medium waveband is now so filled with mush from high-power stations that the weaker and more distant transmissions are drowned. Even when the amplification necessary is there, the noise-to-signal ratio is such that low-power transmissions have no entertainment value. Whether or not this suggested explanation is correct my contention holds true: you require a more sensitive set to-day to provide loud speaker reception, for example, of the 25-kilowatt Sottens (Radio-Suisse Romande) than was needed a few years ago to give even clearer reception from the 1.5 kilowatt Radio Berne.

The difficulties mentioned are largely concerned with the reception of foreign stations, and it is more than likely that the reply of broadcasting authorities to such criticism would be that the listener should make use of his local station instead of trying to bring in programmes from all parts of Europe. But the man-in-the-street has shown in no uncertain manner that he will do no such thing. There

A BOON ?

THE author of this article has not had the last word. Whilst there may be much evidence to support the point of view which he here puts forward, there are at the same time many arguments in favour of high power, and it may be unfair also to assume that interference and lack of selectivity are so largely due to power increases. In next week's issue Mr. M. G. Scroggie will contribute a reply to Mr. Hallows' contentions.



"Wireless World" photo.

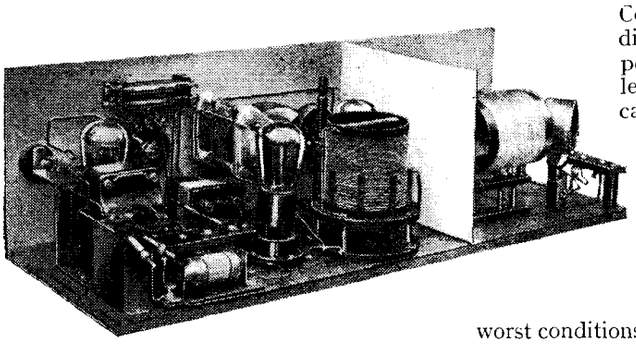
INTO THE FUTURE. Droitwich, the new B.B.C. high-power station, nearing completion.

would be no sale whatever nowadays for a set designed purely for local station reception. The holder of a wireless licence regards the ability to receive foreign stations as a right, once he has purchased a suitable wireless set, and, reasonably or unreasonably, he expects those responsible for broadcasting to enable him to exercise it.

My Views on Service Areas

The crux of the whole matter is to be found, I believe, in the conception of service areas. A service area may be defined as the region surrounding a transmitting station in which the minimum field strength necessary for good reception *with a small receiving set* can be guaranteed all the year round both in daylight and after dark. Such areas are never quite circular; but, roughly speaking, the aim of high-power schemes is to provide the necessary field strength within a radius of from 75 to 100 miles of medium-wave stations and 200 miles or more of long-wave stations.

The present method of going to work is to discover what power will be needed to provide the necessary field strength on the fringes of a service area under the worst possible conditions and then to build a transmitter with power output fixed at the amount thus ascertained. This method may lead to many undesirable results. It is frequently found in practice that a service area is much larger than it appeared to be in theory and that it overlaps other areas considerably. It seems to me absurd that all through the hot dry summer of 1933 my own locality should have been within the service areas not only of the local stations, the London Regional and National and the Midland Regional, but also of the West Regional, the North Regional, the Scottish Regional, Athlone, Langenberg and Hilversum.



A typical "station getter" of the days before the kilowatts race and ether congestion.

Again, since the output power of the transmitter is fixed, the service area, though never contracting to less than its designed radius, undergoes huge expansions under "favourable" conditions.

It is to these expansions of service areas, which are particularly noticeable during the six darker months of the year, that a great deal of our present troubles is due. All through last summer, for instance, there were comparatively few heterodynes either directly between carriers or due to harmonics. With the coming of autumn both kinds of heterodynes increased rapidly in severity. Not a few stations that could be received clearly in June or July had ceased to be worth listening to in October.

The problem, then, would seem to be to find some means of preventing transmissions as far as may be from causing interference outside their own service areas. Complete success in this direction appears to be impossible with the wavelengths now used for broadcasting, but something might be done if transmitters varied their output power to suit the circumstances. To operate a transmitter at all times with the power required for covering its service area under the worst conditions may seem to many to be a rather crude way of obtaining results.

It is as if the designer of a motor car said to himself: "This car may be called upon occasionally to climb hills as steep as one in three; my calculations show me that to surmount such a hill a transmission ratio of 20 to 1 is necessary. I will therefore make my car with a fixed ratio of 20 to 1." Of course, he does nothing of the kind; he provides the car with a gearbox which enables its engine to deal with any gradient that may be encountered. It is not suggested that broadcasting stations should be always fiddling with their output power; but I do think that many of our present problems could cease to exist if stations could work to what may be called an output-power timetable. To give a concrete case, consider a station capable of radiating 100 kilowatts. The maximum output might be used between dawn and dusk in summer time. After dark in summer the power would come down to 50 kilowatts, or whatever was found to be the maximum necessary to cover the service area. In winter the daylight power might be 70 kilowatts, whilst after dark it is possible that 20 or even less would be found sufficient.

The benefits of such a scheme, if it could be worked out and put into practice, would be great. The listener owning a small set unprovided with automatic volume control would be assured of substantially the same signal strength at all times from his local station, so that many of his present worries would vanish. The designer of receiving sets would no longer be perplexed by the problem of combining ultra-selectivity with complete fidelity in reproduction. The reception of distant stations would become easier and the popularity of foreign listening would increase. There would be much less interference between stations in winter and one particular menace the full import of which is not yet realised might be nipped in the bud.

The menace to which I refer is that of harmonics from high-power stations, particularly those on the long waves and in that part of the medium waveband that lies above 400 metres. Any transmitter is liable to radiate harmonics on one-half, one-third, one-quarter, and so on, of its fundamental wavelength. The harmonics behave in very much the same way as transmissions on similar fundamental

Is High Power a Boon?

wavelengths. That is to say, the fourth harmonic of the 1,875-metre Kootwijk, which occurs on 468.75 metres, has the same characteristics as a transmission made on that wavelength. It has, for example, its greatest range after dark. An harmonic can cause heterodynes, and at the moment of writing the fourth, fifth, sixth, and eighth of Kootwijk are responsible for four separate night heterodynes within the limits of the medium waveband. Similar interference is more than likely to be produced by other long-wave stations as increases in power take place. Could their power be varied in this way, interference due to these harmonics would probably be greatly reduced.

My conclusion is that high power is a boon only so long as it serves without swamping. What we listeners require is adequate but not excessive field strength and as little overlapping as possible of service areas. These needs might be met by seasonal variations in the output power of the transmitting stations that provide us with entertainment.

NEWS of the WEEK

Current Events in Brief Review

Programmes from Egypt

A 20-KILOWATT station, organised by the Egyptian State Broadcasting Service, will make its debut on the ether at Cairo next month. Programmes will also be relayed by a smaller transmitter at Alexandria.

New Broadcasting Organ

A PIPE organ of the ultra-modern type is to be installed in the main studio of the Lausanne broadcasting station. The design of the organ has been approved by the organists of Lausanne Cathedral and of the Temple de l'Etoile, Paris.

Anti-Propaganda Pact Declined

THE Swiss Broadcasting Company has rejected the Austrian Broadcasting Company's proposal for the conclusion of a special anti-propaganda pact, similar to that arranged between the Austrian and Czechoslovakian authorities. The Swiss organisation does not consider itself empowered to make arrangements over political questions which come within the domain of Government diplomacy.

Missing His Hobby

M. DOUMERGUE, the French Premier, is reported to have confided to his secretary that pressure of State affairs is depriving him of his two or three hours daily at the broadcast receiver. In his country home at Tournefeuille, ex-President Doumergue was able to indulge in wireless pursuits without let or hindrance. The other day, however, when some prominent radio manufacturers wished to present a new receiver to the Premier, Madame Doumergue graciously stepped in, stating that her husband "needed all his leisure for tranquillity and sleep."

A Watching Brief

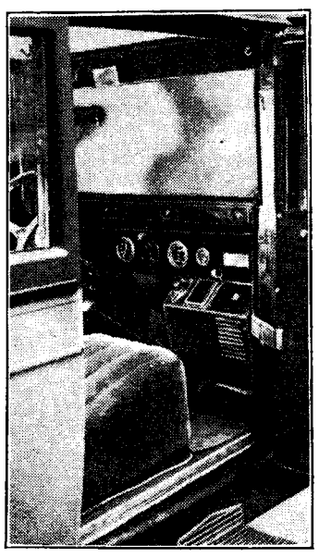
THE League of Nations is to attempt to exert a greater control over European broadcasting. Signor Massimo Pilotti, the Italian Under-Secretary of the League, has been appointed President of the new Telecommunications Committee. National broadcast programmes are to be subjected to daily supervision under the eyes of M. Adrian Felt, Director of the League of Nations Information Bureau.

League of Nations Calling

NEW directional aerials are being tested by Radio Nations, the short-wave station of the League of Nations at Geneva. The intention is to provide a more regular service to Australasia.

Interference "War" at Sheffield

COUNCILLOR F. LLOYD is fighting a battle on behalf of Sheffield listeners to overcome interference by the Corporation tramways system. The Corporation contends that as the tramways system was "first-comer,"



CAR RADIO IN GERMANY. The new Telefunken automobile receiver is a four-valve superhet drawing its entire current from the car battery. It is controlled from the steering wheel.

the responsibility for dealing with interference lies with the Post Office, as the licensing authority, or the B.B.C. Councillor Lloyd has drawn attention to the fact that the proposed tramway extensions, costing £54,000, will aggravate the trouble. He has had over 200 letters from people complaining about interference. As Mr. Lloyd points out, it is quite possible to prevent interference by trams by fitting them with choke coils as is done in most other progressive cities and towns in this country.

We trust that the Sheffield Corporation will see fit to reconsider its present attitude on the subject.

100 kW. from Lithuania

THE Kaunas broadcasting station, Lithuania, now working on 7 kW., is to be rebuilt with a power of 100 kW.

The New Art

A "MICROPHONY CLASS" has been opened at the Poste Parisien broadcasting station to familiarise singers and instrumentalists with the peculiar technique of the broadcast microphone.

Super-Power Station for U.S.?

ACCORDING to our Washington correspondent, American official circles are considering the construction of an international super-power short-wave broadcasting station under Federal auspices, to be employed in interchanging programmes with Latin America, besides originating educational broadcasts for relaying to other countries.

Medal for M. Braillard

M. RAYMOND BRAILLARD, the now-famous Chief of the Brussels wavelength centre, lectured recently before the School of Arts and Crafts at the Hôtel d'Iena, Paris, describing the technical organisation of the International Broadcasting Union. M. Braillard received from the hands of the President the society's gold medal.

Everest Film

EXTENSIVE use of wireless by the 1933 Ruttledge Expedition on Mount Everest gave the venture a special interest for radio amateurs. The story of the expedition is told in graphic fashion in the talking film, "Climbing Mount Everest," which was shown at the Polytechnic Theatre, Regent Street, London, W. The film is now available for display by schools and societies, and Western Electric (Bush House, Aldwych, London, W.C.2), who handle its distribution, have made arrangements whereby the film may be shown on any premises, whether or not talking picture equipment is installed. The hiring fee for the film includes the supply of equipment, while projection is carried out by the company's own operators.

No More Goat Gland?

XER, the "goat gland" broadcasting station of Mexico, appears to have closed down after a relentless fight with the U.S. broadcasting authorities. The station was opened by Dr. John R. Brinkley, whose broadcasts on the subject of goat gland rejuvenation from his station in Kansas were suppressed by the U.S. authorities. His reply was to erect station XER with a power of 150 kW. just across the Texas border in Mexico.

Recording Studios

IN the article "Behind the Scenes at the H.M.V. Recording Studios," which appeared in *The Wireless World* on March 2nd, reference was made to the microphones and recording equipment having been designed in the H.M.V. Research Department. We are now informed that this work should really have been attributed to the EMI Research Department, which is now responsible for the research activities of the companies which form this group.

We are also informed that recent developments in what has been erroneously described as H.M.V. television are actually the product of the EMI Research Department.

Long-wave Plan in Full

THE new experimental Long-wave Plan suggested by the International Broadcasting Union to European Governments will probably be tried out until the end of the year. The full scheme is as follows:—

	kc.	m.
Kaunas	154	1,948
Huizen	159	1,886
Brasov	159	1,886
Lahti	166	1,807
Moscow	174	1,724
Radio Paris ...	182	1,648
Deutschlandsender .	191	1,571
Daventry	200	1,500
Kalundborg ...	240	1,250
Leningrad	248	1,209.6
Oslo...	262	1,145

Minsk, Motala, Kharkov and Warsaw will decide among themselves which of four wavelengths they will employ. The suggested arrangement is as follows:—

	kc.	m.
Minsk	208	1,442
Motala	216	1,389
Warsaw	224	1,339
Kharkov	232	1,293

Reykjavik will share one of the Russian wavelengths.

The remaining stations figuring in the Lucerne Long-wave Plan, namely, Ankara and Madrid I, are not yet built. It is now hoped that Luxembourg will be persuaded to share the 1,304-metre wavelength with Russia.

HINTS and TIPS

Practical Aids to Better Reception

The "Add-on" Idea

WHEN one decides to build an A.C. mains receiver with provision for subsequent additions, the question of anode current supply is apt to give a good deal of trouble. It is obvious that a start should be made with power equipment that will give an ample margin for future requirements, but unless suitable precautions are taken the rise of H.T. voltage which takes place on the light initial load may be distinctly harmful.

Although it may seem distressingly uneconomical to allow electrical energy to run to waste by fitting a parallel loading resistance across the H.T. output, this is really the only practicable scheme in the circumstances that we are considering. The position of the resistance in question is shown in Fig. 1, and it will be worth while to consider for a moment the calculation of its value and the conditions under which it will be used.

As an example, let us imagine that a start is being made with a local-station det.-L.F. "quality" set which requires 350 volts at 70 milliamps. to operate the valves under the conditions recommended by their manufacturers. In order to leave a reasonable margin for subsequent additions, one would perhaps choose a "B" class rectifier, rated at 350 volts and 120 milliamps.: therefore surplus current would be 120 – 70, equal to 50 milliamps. (0.05 amp.). The purpose of the loading resistance is to absorb this surplus current, and its value is calculated by dividing the voltage of the rectifier output by current to be absorbed (expressed as a fraction of an ampere). In the case under consideration the figures are 350 divided by 0.05, and so the resistance required will be 7,000 ohms.

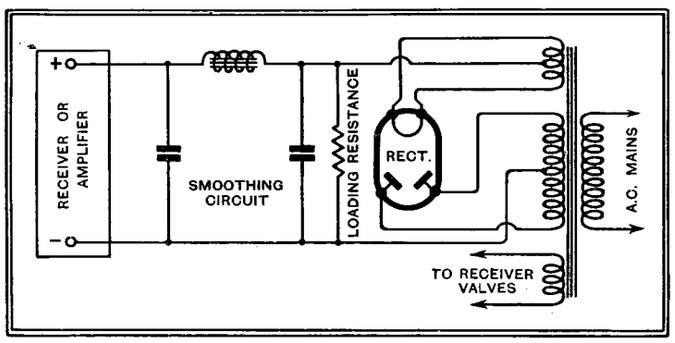


Fig. 1.—An anode current supply unit is easily adapted for varying current outputs by fitting an interchangeable artificial load resistance.

Going a stage farther, we will imagine that an H.F. amplifier is to be added to the original simple receiver, and that for the anode and screening-grid circuits of the valve and for the associated feed potentiometer a total of 15 milliamps. extra current will be needed. The resistance must accordingly be replaced by one having a higher value, calculated on the basis that the surplus current will now amount to only 55 milliamps.

Finally, it should be realised that when a loud speaker field winding is used as a smoothing choke the load resistance should as a rule be connected on the output side of the smoothing circuit, in order that the current which it consumes may be additive to that which normally passes through the field winding.

Universal Mains Sets

IT may seem rather wasteful to fit an H.T. rectifier, whether of the valve or metal oxide type, in a universal A.C.-D.C. receiver which is to be used initially on a D.C. supply, with no immediate prospect of changing over to A.C. Many readers have doubtless felt in these circumstances an inclination to omit the rectifier entirely.

At first sight it would appear to be quite permissible to do so, for theoretically the rectifier serves no useful purpose except when the receiver is connected to an A.C. supply. In actual practice it actually *is* often possible to omit it without harmful results, but before deciding to do so the amateur constructor should bear in mind one or two points.

In the first place, the rectifier acts as a complete barrier, so far as the H.T. circuits are concerned, if the receiver should happen to be connected with incorrect polarity to D.C. mains. No harm is done by this, except in cases where electrolytic smoothing condensers are employed, but this type of condenser is damaged by an accidental reversal.

Again, it is a fact that the presence of the rectifier often tends to clear away certain forms of hum (probably due to a ripple of alternating-current nature which is superimposed on the D.C. supply). The inclusion of a rectifier on this score alone has in some instances been proved to be well worth while. The slight loss of H.T. voltage due to the presence of the rectifier is usually negligible.

If it be decided, in the interests of economy, to try to do without a rectifier, space must, of course, be left for adding it when the set is changed over to an A.C. supply. Do not forget, however, that when following a published design the main voltage-absorbing resistance (R in Fig. 2) must be increased in value in order that it may absorb the voltage that would otherwise be absorbed by the rectifier valve.

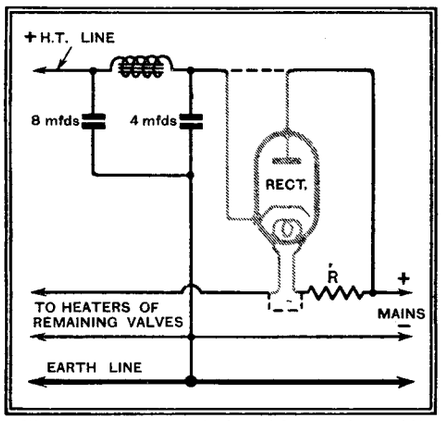


Fig. 2.—When a set designed for "universal" mains use is to be operated on D.C. only, the rectifier may sometimes be omitted: modified connections are indicated by dotted lines.

Aerial Capacity

THERE is a tendency to take the aerial-earth system very much for granted, and never to attempt to carry out an electrical test of its condition. Indeed, it is rather difficult to do so in a conclusive manner, and usually one can assure oneself that everything is more or less in order by a simple inspection.

However, it sometimes happens that all the connections are not easily accessible for examination, and a knowledge of the right way to set about making a rough-and-ready test may be useful.

From the point of view of testing, we shall not go far wrong if we regard the aerial-earth system as a condenser with a capacity varying between 0.0002 and 0.0003 mfd. The electrodes or terminals of this condenser are the aerial and earth lead-in wires; incidentally, the condenser is a highly inductive one, but this does not affect the type of test for which the average amateur has facilities.

The operation of testing, then, is carried out exactly as if one were dealing with a small condenser, the testing apparatus being connected across aerial and earth. Any of the various improvised methods of checking the condition of the condenser may be used successfully, although one hardly expects to find that the insulation of an aerial is as perfect as that of a small condenser. The presence of a more-or-less complete short-circuit would indicate that some part of the aerial wire which is not in sight is making contact with metal guttering, etc., while a low insulation resistance would suggest that the aerial insulation system is due for overhaul.

BROADCAST BREVITIES

By Our Special Correspondent

When 24-hour Time Begins

ON April 22nd next, when Summer Time begins, the B.B.C. will inaugurate its great experiment in 24-hour time.

Thenceforth, all printed programmes and microphone announcements will conform to the new order of things.

Government-controlled B.B.C.

Admittedly, the innovation is a Government move; statements in Parliament have virtually disclosed the fact that the Corporation will be acting under orders. This is a hard thing to say, particularly as Sir John Reith has just assured us that there is no Government control of broadcasting. But there it is.

"Educating" the Public

At one time, I believe, it was felt in Government circles that the railways could be trusted to educate the public in 24-hour time, but wiser counsels prevailed. Undoubtedly, the B.B.C. are the people to undertake the job, for they will bring the 24-hour clock into the home and make a study of it necessary for the complete enjoyment of the programmes.

A Little Confusing?

Where wireless men are concerned, of course, the 24-hour clock is no innovation, but even the hard-boiled "hams" may be a little confused on the 22nd because 6 p.m. G.M.T. will have become 19 o'clock B.S.T.

Unfortunately, there is no room on this page to print a conversion table.

Modest Droitwich

IS the B.B.C. timid where power is concerned? I hear that the Droitwich transmitter, although capable of a full-blooded 150 kW., will not exceed the 120-kW. mark. This may please France and Germany, not to mention Luxembourg, but will cause less satisfaction to the vast number of British listeners who will rely on Droitwich for their National programmes.

Externally, the new station is now complete, but only a small portion of the apparatus has been delivered. Tests can hardly be expected before the middle of May.

Horror on the Air

"SWEENEY TODD," the play to be broadcast on April 9th, may be strong meat for sensitive people, for, as can be guessed, the theme is that of the demon barber who, having slit his victims' throats, unlatched a trap-door, through which the corpses fell to a temporary resting-place.

A New Producer

The play is to be produced by one of the new discoveries at Broadcasting House, namely, L. Gilliam, who was responsible for the "Round the Empire" broadcast at Christmas time. Mr. Gilliam's talents were discovered quite accidentally while he was occupying a junior position on one of the B.B.C. publications.

Sir Malcolm Campbell at the Microphone

FEW motor enthusiasts will care to miss the talk which Sir Malcolm Campbell will give from the National transmitters on Saturday, April 7th. He is to discuss "The Land Speed Record."

No A.T.C.

DESPITE the unprecedented incident at the microphone last week, when a speaker protested against the censoring of his manuscript, the B.B.C. has decided not to alter the existing method of monitoring talks. The responsibility rests with the presiding announcer.

There is certainly no question of installing A.T.C., or Automatic Talks Control, which would function when the emotional tension in the studio reached a certain pitch.

Mrs. Jack Hylton

BRITAIN'S only famous woman dance band leader—Mrs. Jack Hylton—will bring her boys to the B.B.C. microphone on April 21st for a programme lasting an hour.

In Memory of Elgar

AN Elgar memorial concert will be broadcast in the National programme on March 24th. It has been arranged in co-operation with the Royal Choral Society, and the proceeds are to be given to the Musicians' Benevolent Fund. The Royal Choral Society, the London Philharmonic Orchestra and the B.B.C. Symphony Orchestra will all take part, with Sir Landon Ronald and Adrian Boult as conductors. The programme consists of the slow movement from the Second Symphony and "The Dream of Gerontius."

No Scat Music

SCAT singing is not likely to make much headway at Broadcasting House, where the Effects Department can provide all the "scatty" noises that may be necessary. Indeed, I am not sure that American dance music is not falling under a cloud.

The same tale comes from New Zealand. A correspondent sends me a clipping from the *New Zealand Radio Record*. It says: "Blame whom you will, there is no gainsaying the fact that English light music is definitely supplanting American jazz in New Zealand. Some of the best-sellers in the music world in the past twelve months have been English compositions. New Zealanders definitely prefer light music and suppressed melody, rather than the "hot" rhythm and harmony of negro players.

A PROGRAMME SUGGESTION FOR THE B.B.C. The Trautonium—the new valve-operated musical instrument—is here seen in use in the home. The sounds are reproduced on the loud speaker of the radio set. Considering the number and variety of "electronic" instruments now available, the B.B.C. might provide listeners with an entertaining programme of electrical music.

B.B.C. AND 30-LINE TELEVISION

ALTHOUGH, as we go to press, the B.B.C. has not issued an official statement on the subject of 30-line television tests, we understand that the official attitude as outlined in answers to correspondents is that the continuance of these test transmissions is intended solely to cater for the requirements of experimenters. The Corporation does not consider that the tests have sufficient entertainment value to warrant the number of programmes now radiated every week, nor does it believe that there is any likelihood of developments in this type of television transmission.

With regard to the suggestion that subjects, such as speakers, variety artists, etc., should be televised, the official feeling is that the flickering scanning light might cause embarrassment. With regard to the further suggestion that television transmissions are being restricted at a time when improved receivers are about to become available to the public, it is pointed out that 30-line transmissions have been radiated for over four years, and the present series began in August, 1932. The B.B.C. feels some responsibility in the matter of encouraging the public to buy equipment which may become obsolescent. It is better, in the opinion of the Corporation, to restrict or abandon 30-line transmissions and concentrate upon developments in high definition transmissions which, in the case of the B.B.C., must form the basis of future progress.

Quality and the "Talkies"

Elimination of Background Noise in Sound Film Reproduction

IT has been a noticeable feature in the development of all forms of mechanical sound reproduction, that the public has accepted a low standard of reproduced quality during the early life of the science. One advance which has been readily accepted and appreciated, however, is the gradual removal of background noise from the reproduced speech and music, in connection with which the British Thomson-Houston Co., Ltd., Rugby, has carried out much research work, and to whom we are indebted for the information in this article

UNTIL recently reproduction from talking films has been marred by an accompanying background of hissing and scratching sounds, which were particularly noticeable during the quiet and silent passages of the film. This was not only objectionable in itself; it was also a difficulty in the path of two other major developments in the talking film art—the extension of reproduced frequency range and volume range. In the first place, the main component frequencies of this background noise are fairly high in the audio-frequency scale (about 4,000 cycles per second), and so the recent increase of reproduced frequency range to 10,000 cycles per second in the upward direction would have greatly aggravated

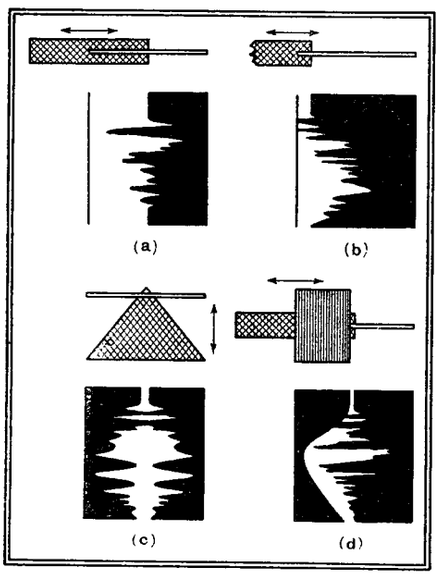


Fig. 1.—Four types of variable area positive track.

this trouble had not a successful means of reducing background noise been made available. The volume range recorded on a film is limited in the upward direction by the physical width of the track used for the photographic sound record, and the weakest sound which can be recorded and reproduced is limited by the background noise. The introduction of background noise-eliminating methods have thus materially increased the available volume range by making it possible to reproduce sounds which would previously have been masked.

There are a number of causes of reproduced background noise, such as:—

(*a*) Recorded extraneous sounds.

(*b*) Audio-frequency disturbances generated in recorder or reproducer.

(*c*) "Shot" effect which is noise produced by the photo-electric cell.

(*d*) Variations in the density of the nominally clear part of the film due to emulsion structure and any dirt or scratches which may collect during its useful life.

The first three can be taken care of by careful design of the equipment, and this article is chiefly concerned with (*d*).

Film Grain and Dust

This can be divided into two sections, the ground noise with which a new film starts its life, and the noise due to dirt and abrasion collected during its useful life. In each case we are mainly concerned with the clear or transparent parts of the track, because here a very small change in density represents a large relative change, whereas a similar change on the dense part of the track would make only a small relative difference.

The noise from a new film is due to the fact that the reducible substance in photographic emulsion is silver nitrate, in the form of grains of reasonable size. This granular structure can be seen under a microscope on the transparent part of the track, and it has the effect of modulating the excitation light in the reproducer to produce a background hiss. This effect is accentuated by the slight chemical and photographic fog which is inseparable from the processing operation.

The added background due to dirt and abrasions collected during life is kept down to a reasonable level by careful handling of film in the theatres.

In Fig. 1(a) is shown the original form of positive variable area sound track, in which the width of the black portion at any instant is proportional to the recorded volume, whilst the distance between successive peaks in the recorded wave form is a function of the frequency of the recorded sound. It is not proposed to discuss here the methods by which the track is recorded or reproduced, but above each form of track shown in Fig. 1 will be seen the arrangement of the mechanical slit and the form and position, in its stationary or unmodulated condition, of the recording light beam. It should be noted that the tracks are shown in the positive form, and are the photographic opposite of the nega-

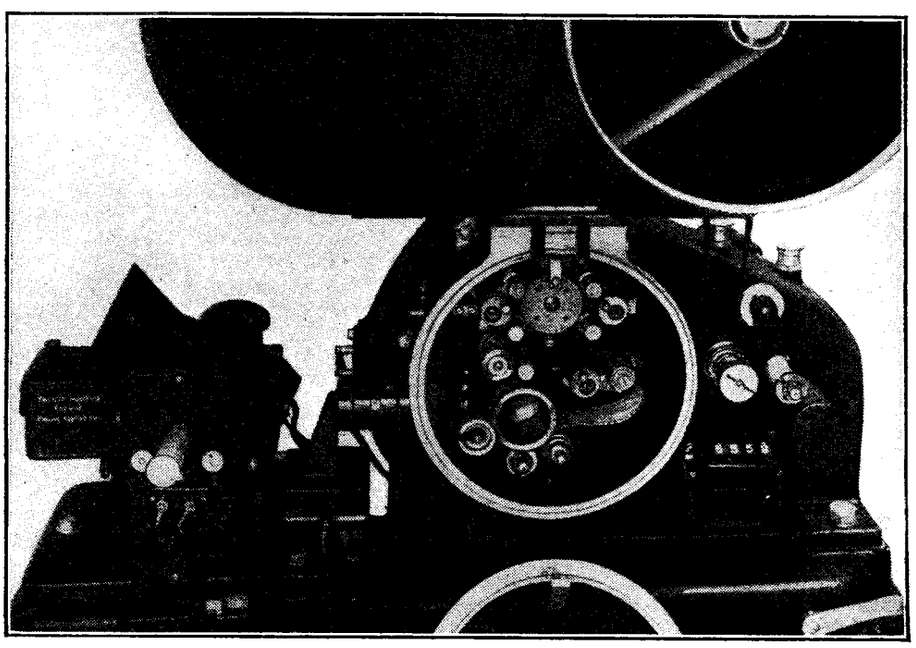


Fig. 2.—A typical sound camera with the ground noise eliminator shutter incorporated in the recording optical system.

Quality and the "Talkies"—

tive track that would be formed by the recording arrangements shown.

An unmodulated form of a variable area track need not consist of two bands of equal width, one clear and the other dense, with modulation taking place about their dividing line. It can equally well take the form of a track which is dense over its whole width during unmodulated passages, providing that it is arranged that the track assumes its normal form for full amplitude signals, and that correct relative widths are arranged for all intervening depths of modulation.

Three well-known forms of variable area positive track with ground noise elimination are shown in Fig. 1(b), (c), and (d). In that shown in (b) the base line of the recorded wave shape has been moved from its normal central position to a position almost on the edge of the track during silent passages, but is arranged to move over towards its centre position as the amplitude rises. This is obtained by setting the recording edge of the light beam in its zero position to one end of the mechanical slit. The recording galvanometer which oscillates the beam to trace the wave form of the recorded sound is then biased with a direct current proportional to the modulation in such a way that the mean position of the light beam is moved over as required.

This method of ground noise elimination suffers from the defect that all small amplitude sounds are recorded at the edge of the track. This is rather serious, because it requires great care in alignment of the reproducer scanning slit to ensure that it covers the whole width of the track. A variation of this method to take care of this defect is shown in Fig. 1 (c).

In this case the recording galvanometer is turned through 90° with respect to the mechanical slit, and a triangular aperture used in the light source in place of a rectangle. The galvanometer is again biased at zero modulation to bring the apex of the beam down to the mechanical slit. It will be seen that a track recorded in this way consists of two symmetrical records placed one on each side of the centre line. During quiet passages the whole track area is black and the axes of the two wave forms almost coincide in the centre. As the modulation increases these axes move outwards to positions respectively $\frac{1}{4}$ and $\frac{3}{4}$ across the width of the track.

The third form of recording shown in Fig. 1 (d) makes use of a separate ground noise-elimination shutter to trace in the envelope of the recorded wave shape. Fig. 2 shows how this shutter is mounted in the recording optical system of a typical sound camera.

Although this description of ground noise-reduction methods has been concerned primarily with the variable area form of track, it will be evident that a similar method may readily be adapted to suit variable density recording. In this case the unmodulated track has a density which is the mean of the minimum densities to which the track is exposed. Modulation then takes place about this mean density. To obtain reduction of ground noise, the zero modulation density is taken up to the maximum and then lowered towards its normal value in proportion to the amplitude of the recording.

New Metal Rectifier

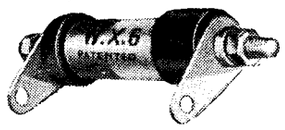
Low-capacity Westector for Signal Detection

THE ordinary Westector has now been available for some considerable period, and has proved very serviceable in superheterodyne type receivers. At the comparatively low frequency employed for the intermediate frequency, it can provide satisfactory detection, and it can also be used for A.V.C. purposes. Attempts to employ it as a detector in a straight set, however, have not proved wholly successful, for the high capacity of the rectifier has rendered operation rather inefficient.

A new Westector, the type WX6, is now available in which these disadvantages have been largely removed by a substantial reduction in the capacity of the rectifier. The makers' claim, in fact, that it is as satisfactory in a straight set as the older type has been in the superheterodyne. In its appearance it is very similar to the older type, and it is equally applicable to the superheterodyne.

The makers' rating for the component places an upper limit to the permissible input of 30-40 volts, and it is capable of passing a current of 0.1 mA. It is recommended that it be used with a load resistance of some 250,000 ohms, with which value a shunt condenser of 0.0001 mfd. is suitable. The rectification characteristic is linear for inputs exceeding 2 volts, so that detection of an 80 per cent. modulated carrier will be distortionless if the carrier voltage is above 10 volts. This indicates a degree of linearity comparable to that of the average valve diode. At inputs less than 2 volts the characteristic approaches a square-law, and it is then recommended that a small initial bias be applied.

In addition to serving as a second detector and A.V.C. source in a superheterodyne, it is possible to use the new Westector as a first detector. It is claimed that this is advantageous, in so far as detector overloading becomes out of the question, and the only precaution necessary is to see that the coupling to the oscillator is sufficiently tight for the oscillator voltage to be always greater than the signal. The rectifier, of course, gives no amplification, so that to maintain



The new WX6 Westector.

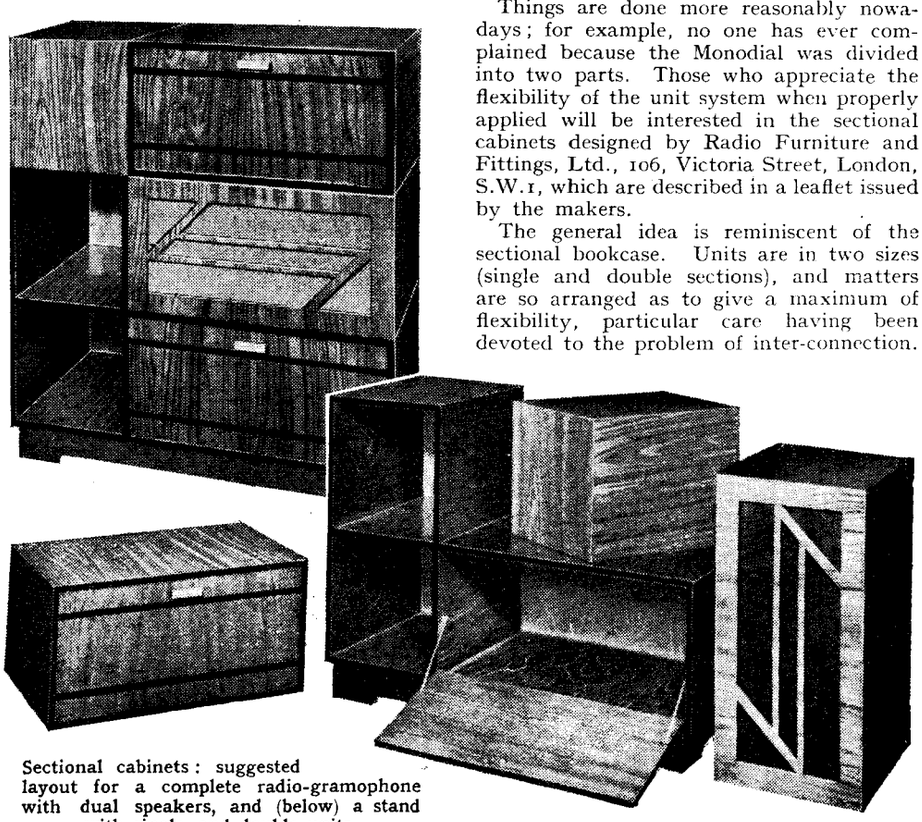
normal sensitivity the valve which it displaces must be connected as an H.F. or I.F. amplifier. Probably the chief use of the new rectifier, however, will lie in A.V.C. systems for straight sets, for when connected in the usual way to the anode of a grid detector it will give a much greater output at high frequencies than the old type. Furthermore, the A.V.C. bias will be much less likely to vary with frequency. Using a voltage-doubling circuit, a bias output of over 20 volts at 300 metres is claimed to be possible.

UNIT RECEIVERS—NEW STYLE

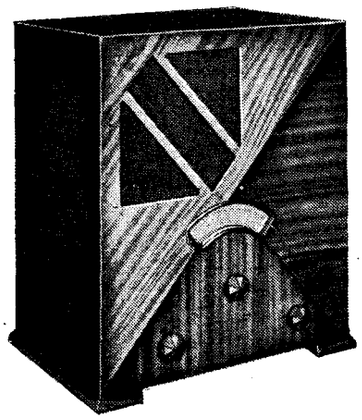
SOME twelve years ago broadcast receivers were often constructed in the form of inter-connected units—H.F. amplifier, detector, L.F. unit, etc. The system did not survive, probably because the mistake was made of introducing too much sub-division—in other words, of building far too many separate units.

Things are done more reasonably nowadays; for example, no one has ever complained because the Monodial was divided into two parts. Those who appreciate the flexibility of the unit system when properly applied will be interested in the sectional cabinets designed by Radio Furniture and Fittings, Ltd., 106, Victoria Street, London, S.W.1, which are described in a leaflet issued by the makers.

The general idea is reminiscent of the sectional bookcase. Units are in two sizes (single and double sections), and matters are so arranged as to give a maximum of flexibility, particular care having been devoted to the problem of inter-connection.



Sectional cabinets: suggested layout for a complete radio-gramophone with dual speakers, and (below) a stand with single and double units.



"Alba"—52

A Low-priced General Purpose "Straight" Set

FEATURES. Type.—*Three-stage "straight" receiver for A.C. Mains.* **Circuit.**—*Variable-mu H.F. stage with band-pass coupling to screen grid detector—power pentode output valve. Full-wave valve rectifier.* **Controls.**—*(1) Tuning with illuminated semi-circular scale. (2) Volume control and on-off switch. (3) Wave-range and gramo. switch.* **Price.**—*£9 19s. 6d.* **Makers.**—*A. J. Balcombe, Ltd., 52/58, Tabernacle Street, London, E.C.2*

THE chassis fitted in this table-model receiver is the same as that used in the "Alba" Model 72 radio-gramophone, and is of the H.F.-det.-L.F. type, which has proved so successful in providing good entertainment at a relatively low cost. Both the H.F. and detector valves are of the screen-grid type, and it is interesting to note that the band-pass tuner has been incorporated in the coupling between the two valves, instead of in the aerial circuit as is more usual.

Only the secondary of the aerial input transformer is tuned, but a combination of magnetic and electrostatic coupling has been employed to give even amplification over the wave-range. Volume is controlled in the variable-mu H.F. stage by simultaneously varying the bias and screen potential, and a part of the wave-range switch is arranged to short-circuit the screen grid to earth when reproducing gramophone records. Incidentally, the volume control operates also on the gramophone pick-up, and under these conditions the lower section of the volume control resistance forms a potentiometer with a fixed resistance in series with the pick-up to prevent overloading.

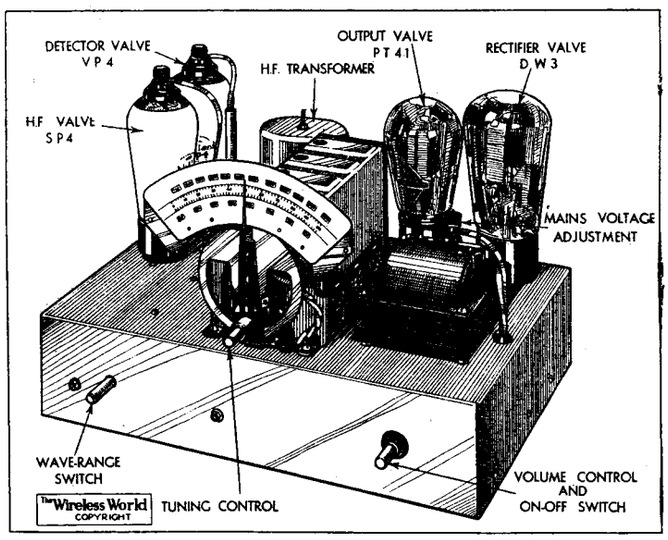
When changing over from radio to gramophone no alteration is made to the negative bias of the detector valve and it would appear that a value has been chosen which gives a good compromise for rectifying and amplifying conditions. The detector is resistance-coupled to the pentode output valve, the bias for which is obtained by a potential divider connected across the loud speaker field. The latter is connected in the negative H.T. lead for smoothing.

A full-wave valve rectifier is employed and the primary of the mains transformer is screened. A mains aerial connection is available through a wander plug on the aerial terminal panel at the back of the chassis. The latter is neat in design and well constructed, and is simple but effective.

Mains voltage adjustment on the top of the transformer winding is a feature which attracts favourable notice.

The feature of the performance which impressed us most was the exceptionally good volume obtainable before overload distortion became apparent. The clear-cut quality of reproduction and the absence of cabinet resonance combined to give the effect of a receiver of much higher price.

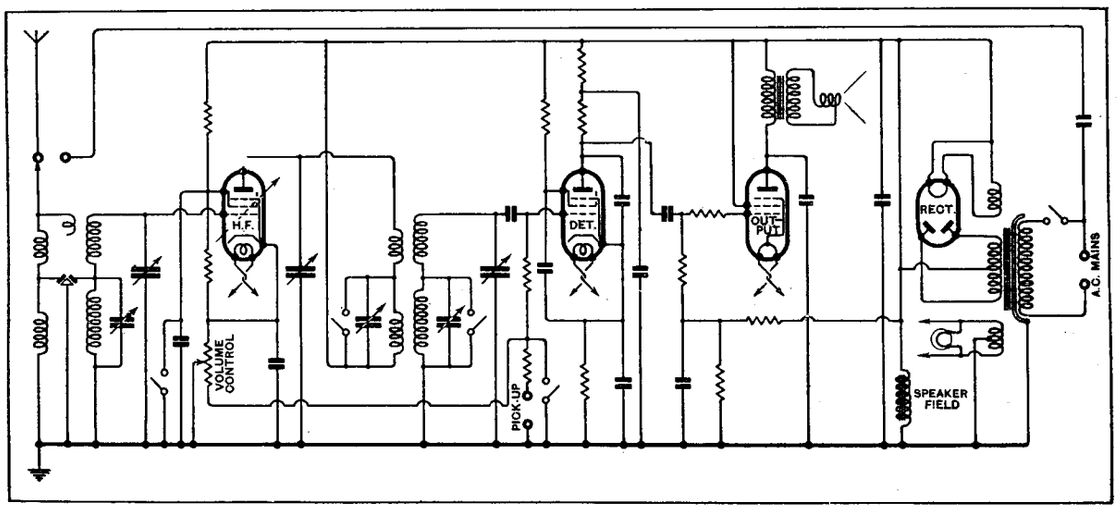
It would be a mistake to think that because the set is not a superheterodyne that the range will fall short of modern requirements. It is safe to say that with this set every station of sufficient strength to rise above the level of background noise will be available to the listener. If anything, the range on long waves is slightly better than that on the medium waveband, but the latter is able to provide five or six foreign programmes in daylight in the London area. In this district there is a fairly substantial background of Daventry when listening to Konigswusterhausen, but on the medium waveband clear reception was possible, 40 kc/s on either side of London Regional and about 45 kc/s the London National station.



A simple but effective mains voltage adjustment is a feature of the "Alba" Model 52 chassis.

The tuning scale is calibrated in degrees, but wavelength markings are provided at intervals of 50 metres on medium waves and 100 metres on long waves. The controls handle nicely, and the octagonal tuning knobs are engraved to show the appropriate settings. The cabinet measures 17×15×10in., and the mounting of the loud speaker in the top left-hand corner, although unusual to the eye, appears justified, having regard to the good quality of reproduction.

The design of the of the cabinet is certainly unique, but the manner in which the walnut veneer panelling has been toned and shaded ensures that it will not be too obtrusive in appearance or clash with existing furnishing schemes. There can be no doubt that the purchaser of this set will be satisfied with the entertainment value which he receives for his money.



Complete circuit diagram. The band-pass filter is connected between the H.F. and detector stages.

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page

Frequency Band Width

THE constructor of a superheterodyne receiver complains that a large number of transmissions are marred—particularly after dark—by a heterodyne whistle of extremely high pitch. Otherwise the set is extremely satisfactory, and troubles from "intelligible interference" are practically non-existent, at any rate on the medium waveband.

Our correspondent is, we think, in error when he goes on to ascribe his troubles to the Lucerne Plan. It seems likely that he has been over-ambitious, and has adjusted his receiver circuits to cover an excessively wide band width. As a result of this, and possibly because the high-note response of the receiver is exceptionally good, a heterodyne whistle, produced by stations working with a 9-kilocycle separation, is audible as a note of constant pitch.

In all probability the primary and secondary windings of the I.F. transformers are coupled too closely, and we suggest that the effect of looser coupling should be tried. This will involve some sacrifice in high-note response, but, in view of the present allocation of channels, this is inevitable if heterodyne interference is to be avoided.

Alternatively, it would be worth while to consider the possibilities of fitting a whistle filter, which could be thrown into circuit when required.

Combined Charger

REFERRING to the battery charger of which constructional details were given in our issue of February 2nd, a reader enquires whether the device could be employed for charging the high-tension as well as the low-tension accumulator batteries of his receiver. It is, of course, obvious that the 2-volt output of the device is capable of charging a 2-volt cell; it is with regard to the H.T. batteries that our correspondent is in doubt.

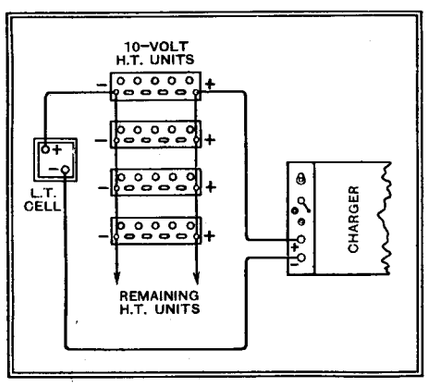


Fig. 1.—Series-parallel charging: H.T. and L.T. batteries connected across the 12-volt output of a "home charger."

As the instrument in question is intended for both radio and car accumulators, it includes provision for charging 12-volt batteries, and therefore the simplest plan will be to join the low-tension accumulator in series with a parallel-connected bank of 10-volt H.T. units in the manner indicated in Fig. 1. As our correspondent is using a total of 15 units (=150 volts), it follows that when connected in this way to a charging source giving 1 ampere, individual units will be charged at 1,000 ÷15=66 mA. approx. Of course, the L.T. cell will be charged at 1 ampere. These rates will be suitable enough for trickle-charging the majority of H.T. and L.T. accumulators in ordinary use.

Aerial Wire

A CORRESPONDENT enquires whether any benefit is likely to be derived from the use of insulated aerial wire in place of the more usual bare copper wire.

Electrically speaking, an insulating covering confers no benefit whatsoever. Neither does it add anything to mechanical strength, but only tends to increase the weight and windage of the aerial, and so greater strains are imposed on the masts or other supports. Against these disadvantages must be set the fact that a covering does protect the aerial wire from the corrosive effect of the atmosphere, and so prolongs its life.

A coating of good enamel is possibly the best form of protection, as it does not increase either the weight or windage of the wire to an appreciable extent.

Directly Calibrated Dials

WRITING on the subject of station-calibrated tuning scales, a reader asks for advice as to what stations should be inscribed on his indicating dial. He is, of course, chiefly concerned with "common" channels, which are occupied by more stations than can be shown on the dial.

Clearly, it is wrong to sacrifice clearness by including a number of stations that can seldom, if ever, be received clear of interference. We suggest that all the official channels should be marked on the dial, with the names corresponding to those that are exclusive to one transmitter. With regard to channels shared by two stations only, there is generally room for both names, but when a large number of small stations share a wavelength, it may be marked as "common." It will be found helpful if the names of those stations on which one generally depends for programmes are marked on the scale in distinctive lettering.

H.F. Anode Current

IT is always rather tempting to measure the anode current of a screen-grid valve by removing the existing wire from the anode terminal and then interposing a milliammeter in the circuit. Connections are easily made, and there is no need to disturb the wiring.

But, more often than not, the addition of the meter and its leads will provoke instability. Any reading of current taken while the valve concerned is in a state of self-oscillation is misleading, and we think that this effect is responsible for the perplexities of a reader who finds that anode current depends on the wavelength to which his set is tuned!

Charged Grid Condenser

IT was recently pointed out that the condition of a valve may be roughly checked by changing its working grid bias, and at the same time watching the behaviour of a milliammeter connected in the anode circuit. If an appreciable change in current takes place, there can hardly be anything very radically wrong with the valve.

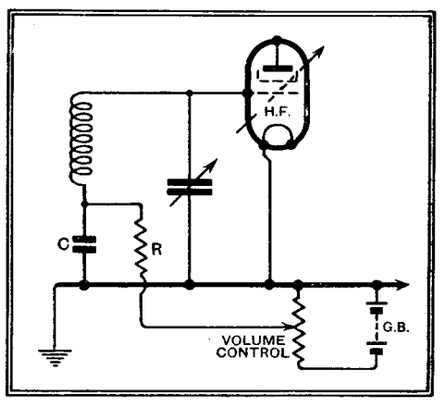


Fig. 2.—A charge accumulated in the by-pass condenser C will provide grid bias voltage for a short period after the source of supply has been disconnected.

A querist has applied this method of testing to the H.F. amplifying valve of his receiver (see Fig. 2), and is puzzled because there is no change of anode current whatever, although the receiver is apparently just as sensitive as ever it was. His method of making the test is to raise the potentiometer slider arm momentarily so that it breaks contact with the resistance element.

This is not a conclusive test. The "snag" lies in the fact that the by-pass condenser C becomes charged to a voltage corresponding to the value of applied grid bias, and, if insulation is good throughout, the valve will continue to receive bias voltage from the condenser for an appreciable period of time—at any rate for a matter of seconds, the exact time depending upon the capacity and the excellence of insulation.

In a case like this a test may be carried out very simply by rotating the potentiometer and noting whether anode current changes in sympathy.

The Wireless World

INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

New Apparatus Reviewed

Latest Products of the Manufacturers

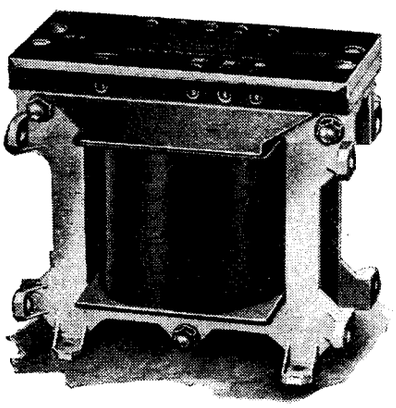
DAVENSET AUTO-WOUND TRANSFORMERS

PARTRIDGE, WILSON AND CO., Davenset Works, Evington Valley Road, Leicester, include in their range of mains transformers a series of auto-wound models for stepping the supply voltage up or down. As a step-down transformer this style could be employed when it is required to operate a receiver designed for a 100-110-volt supply from mains of 200-250 volts, or *vice versa*.

They employ a single winding tapped at suitable intervals, the tappings being brought out to a terminal board in the usual manner with the input and output connections separate and appropriately marked. The 100-110-volt tappings are duplicated, one set being for use when the transformer steps up and the other when it steps down the voltage. This ensures that the compensation for voltage drop in the windings is correct whichever way round the transformer is connected.

The specimen tested is listed as the model No. 19, and is rated at 75 V.A. Connected as a step-down transformer, and the output measured with various loads on the 110-volt tappings, it showed particularly good regulation. With loads varying between 20 and 75 V.A. there was a change of two volts only in the output, the measured values being 116 and 114 respectively. On full load its efficiency was of the order of 90 per cent.

In common with all Davenset products the workmanship is of the highest standard. Well-finished cast end-plates are fitted, giving three alternative positions of mounting, and a neat moulded bakelite top-cover completely encloses the tapping leads. It carries also the small brass connectors, which are sunk below the top of the cover for protection against accidental short circuit.



Davenset auto-wound transformer for stepping supply voltages up or down.

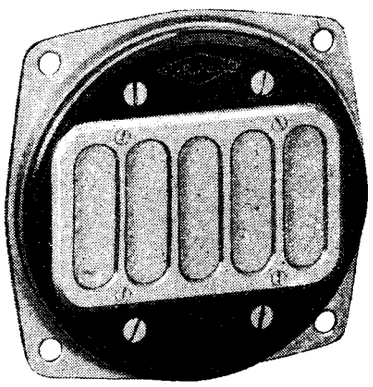
There are five models in the series, ranging from a 35 V.A. size to one of 350 V.A. rating. The smallest costs 17s. 6d., and the largest 50s.; the one tested is priced at 22s. 6d.

PARMEKO MICROPHONE

DURING the past few years considerable attention has been given to the design of microphones for use with public address systems, for band repeating, and for the numerous other purposes to which microphones are to-day applied. A recent addition is the Parmeko model, a high-grade transverse current carbon microphone made by Partridge and Mee, Ltd., Parmeko Works, Leicester. It is fitted with a mica diaphragm and measures $3\frac{7}{8}$in. in diameter and $1\frac{3}{4}$in. deep overall, and four projecting wings are provided in which holes are drilled for fixing it to a stand by suspension springs.

This microphone will operate satisfactorily with polarising voltages of between 4 and 10, and it passes about 30 mA. with the maximum voltage. Using an amplifier of moderate gain the best results will be obtained by applying the highest voltage.

A step-up transformer with a ratio between 1 to 20 and 1 to 30 is needed, and its primary impedance should be approximately 500 ohms at 100 c.s. Operated in



Parmeko transverse current carbon microphone.

the correct manner the microphone has a good frequency response, and its sensitivity is adequate for all normal needs. Microphone hiss, characteristic of most carbon types, is barely perceptible. It is an exceptionally well-made instrument, and the price is £7 7s.

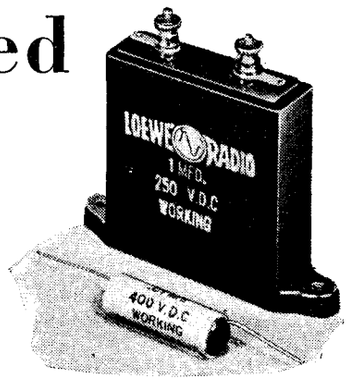
LOEWE CONDENSERS

A RANGE of paper condensers rated at 250 volts D.C. working and known as the type LR220 was recently introduced by The Loewe Radio Co., Ltd., Fountayne Road, Tottenham, London, N.15. They are enclosed in bakelite cases fitted with screw terminals and are made in 1-, 2-, and 4-mfd. sizes, the price being 2s., 2s. 6d., and 4s. respectively.

It is stated that these condensers are tested at 500 volts D.C., but we found that the margin of safety is considerably greater than inferred by this, since all our specimens successfully withstood a potential of 800 volts D.C. Despite this, however, the normal working voltage should not be exceeded, as, although much higher potentials will not lead to an immediate breakdown, the dielectric stresses will be greater than intended, and failure may occur eventually.

The measured capacities of some 1-mfd. samples were on the average about 14 per cent. low, but that of the 2-mfd. size tested was within 3.5 per cent. of its marked value.

There is available, also, a series of tubular paper condensers enclosed in Paxolin tubes and fitted with wire ends which are made



Loewe one-mfd. LR220 paper condenser, and one of the new tubular type.

in sizes ranging from 0.00005 mfd. to 0.5 mfd. They are rated at 400 volts D.C. working, and tested at 1,500 volts D.C., the price being 6d. up to 0.02 mfd., 8d. for one of 0.05 mfd., 9d. for a 0.1 mfd. size, while the 0.25 and 0.5 mfd. models cost 11d. and 1s. 2d. respectively.

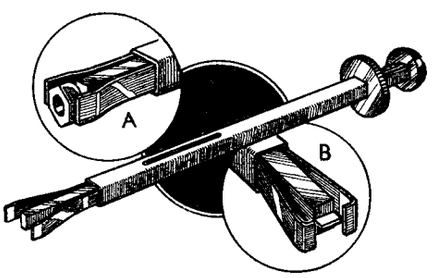
SHARR'S NUT AND SCREW SETTERS

THESE tools have been developed to facilitate inserting screws and holding nuts in awkward corners to reach which with ordinary tools would be extremely difficult and might even necessitate much dismantling of adjacent parts. They will lighten the work of the home constructor not only in the building of sets but also in the replacement of components should at any time this be necessary.

The screw setter consists of a square stem of hardened and tempered steel on the end of which is a driving nib that fits into the screw slot. Between the stem and the outer brass sleeve are two steel spring leaves with their ends bent inward to form a small chuck that grips the screw just below the head.

This tool is used to insert the screw and drive it partly home, the final turn or two being completed with an ordinary screwdriver. There are two other styles similar in construction, but designed for holding nuts. One grips the nut for endwise operation, and the other holds the nut parallel with the side of the tool.

These tools accommodate screws and nuts of every size used in radio work, and they cost 2s. 6d. each. The makers are F. J. Sharr, 5, Mayfield Avenue, Woodford Green, Essex.



Sharr's nut setter (A) and screw-gripping tool (B) for inserting screws in awkward positions.

New Universal Valves

A RANGE of Micromesh A.C./D.C. valves for connecting in series will be released shortly by Standard Telephones and Cables. All valves consume 0.2 amp., the heaters being rated at 13, 26 or 40 volts. The range includes an H.F. pentode, a pentagrid frequency changer, a double-diode-triode, two output pentodes, and a rectifier.

Letters to the Editor:—

Progress!

The Listener's Birthright : Service

The Editor does not hold himself responsible for the opinions of his correspondents

Progress!

I AM amazed that "Free Grid," who, in my estimation, possesses the only truly scientific mind on your staff, and the only brain unbiased by the defect of humour, should have neglected any reference in his contribution in your Progress Number to the wonderful advance of television during the period under review.

May I be permitted to remind your readers that this progress has been very real? Having reduced the programme available to the majority of television enthusiasts to one hour during the week in 1934, the B.B.C. was able to report that by the beginning of 1935 they had direct evidence that the number of 30-line receivers in use had gone up to a quarter of a million. Therefore they continued their progressive policy by cutting down the programme to half an hour a week. This having resulted in another enormous gain in the numbers of those interested, the programme time was steadily reduced until, in 1945, complete success was reached by putting out 200-line programmes on a wavelength of 5 centimetres from the top of Broadcasting House, which programmes could just be received by those living within two miles of Langham Place.

The enormous boom of house property within the area served was one of the great features of the next two years. You will remember that over a million television cranks assembled within the favoured area, but that there were still more than two million unsatisfied enthusiasts.

Greatly to the distress of the B.B.C., who were convinced that their policy was the right one, and that criticism was both absurd and unkind, these two million-odd revolutionists subscribed £1 each, and, through the three British television companies, who were still existing in holes in the corner, bought the Fécamp and Luxembourg stations and gave us our present very excellent twelve-hour-a-day 60-line transmissions.

Surely, Sir, "Free Grid," in his admirable review of progress, should not have neglected the sincere vote of thanks which those of us who have laboured in the cause of television owe to our far-sighted B.B.C.

ERNEST ROBINSON.

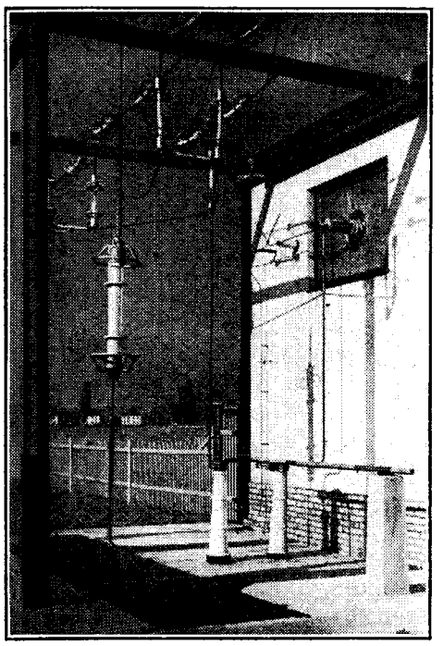
April 1st, 1947.

The Listener's Birthright

THE letter from Mr. Carpenter in your issue of January 26th does not, in my opinion, express the ideas of the majority of listeners at home, and may be thought to be not worth answering. As, however, I happen to be in a position of being able to put forward another side of the question, which obviously has not struck Mr. Carpenter, and therefore in all probability a great many other home listeners, I propose to try to explain it.

Mr. Carpenter refers only to Colonial listeners, to the exclusion of those in the Dominions, so I will do the same.

I do not know how Mr. Carpenter arrives at a maximum of 20,000 listeners in the Colonies, but I am quite willing to accept it as a reasonable one as based on the number of white inhabitants given in the B.B.C. Year Book issued a few weeks ago. What I should like to know from Mr. Carpenter is the number of these who visit the U.K. every year and pay their 10s. for a listener's licence. I am quite sure that the number is a very large one, but I have no means of arriving at any definite figure. I can only tell him that there are eight ships a month carrying an average of seventy passengers each to the U.K. from British Guiana, Trinidad and Barbados alone in April, May and June. How many of this number are listeners I do not know, but I do know that those who are pay 10s. each in the U.K. and 10s. each in Trinidad at least. It seems improbable that any Colonial Government today omits to collect 10s. from listeners under its control. Mr. Carpenter says that we have no "rights" at all. Why not? These Colonial Governments, so far as I know, do not send any fraction of our 10s. to the B.B.C., but that is distinctly contrary to the wishes of every Colonial listener with whom I have discussed the subject and may be taken as universal.



This intricate system of insulators belongs to the Prague high-power broadcasting station at Liblice. The aerial tuning gear is in the small house on the right.

Mr. Carpenter's letter also gives the impression that he thinks that we are given special programmes. The majority of the programmes sent out by the Empire transmitters are the home programmes and therefore cost nothing whatever beyond the actual cost of radiation. Most of the programmes broadcast at hours when they cannot come from the home studios, owing to the time at which they have to be radiated, are merely electrical recordings of programmes previously broadcast to home listeners, or gramophone records. Some portions of the Empire would, therefore, benefit directly from any improvement in home programmes. Apparently this would annoy Mr. Carpenter even though it entailed no extra expense whatever for sending them to the Empire beyond the cost of radiation. When Mr. Carpenter states that the standard of living in the Colonies is higher than at home he merely again shows that he does not know what he is talking about, especially as he seems to refer particularly to the working classes.

60° WEST.

Correspondence, which should be as brief as possible, should be addressed to the Editor, "The Wireless World" Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Service

MAY I take up a little of your valuable space in reply to the letter from "F. L. C." in the February 23rd issue of *The Wireless World?*

As one of that fraternity of service engineers in charge of the service department of the largest radio shop in this town, I beg to inform "F. L. C." that we do not *maul* any set about, and any engineer that takes an interest in his job generally treats the set as a precision instrument, and goes about the repair in a systematic way by eliminating all the possible parts that may be faulty, and having found the faulty part returns this to the makers for replacement.

Some of the manufacturers could ease the lot of the service engineer by making their sets more accessible, as some of them need a tin-opener to get at some of the coils.

With regard to the other point in "F. L. C.'s" letter, that of how many sets are returned to the makers?

May I inform him that on an average I handle between 200 to 300 bench repairs during three months, and during the whole ten years of servicing I have only returned about twenty sets, and these consist mostly of sets with coil trouble which needed the tin-opener, or sets where the maker stipulates return should coil trouble occur.

Of course I am not giving any figures of the number of sets that come in faulty from the makers, very big percentages at times, especially after a new type is brought out. Nearly every set needs some adjustment when unpacked, but only those that are really dud go back.

Trusting you will find room for this reply,

Colchester. H. V. WATTING.

A Reader's Need

FOR certain experiments with electrical music I need some form of progressive contact, i.e., in which the contact-resistance decreases rapidly but continuously under pressure. Some form of compression rheostat seems likely, but it must be very small (say ½in. cube), work under finger-pressure, and stand repeated and rapid actuation. Can any manufacturer help?

"Les Lavandes," au Liouquet, La Ciotat (B-du-R), France. R. RAVEN-HART.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Single-span Tuning

A New Receiver Principle

SOMETIMES we are tempted to imagine that finality in receiver design has almost been reached and that no very radical changes are to be expected in the future. It is never safe to arrive at any such conclusions, for progress is continually taking place and every new step discloses the possibility of others.

It is common knowledge that in the design of the modern receiver the most frequent sources of failure are to be met with in the contacts of wave-band switches and in matching and ganging tuned circuits, necessitating in addition carefully adjusted values of coils and condensers.

The New System

A most important advance in receiver design has just been achieved by *The Wireless World* which at one stroke overcomes all these objections and many others besides. Preliminary details of this remarkable new receiver development, which for the purpose of identification we will call single-span tuning, are published in this issue. This first descriptive article, which will be read with interest, will be followed by further information and a complete design for building a receiver employing this principle. The simplicity of the coils required and the absence of necessity for matching are points which will appeal especially to those readers who prefer to make their own parts as far as possible, but have been unable to do so where coils have required precise matching and complex switching arrangements.

This principle in receiver design is likely to find many special applications, particularly where freedom from faulty contacts and complications are so important, as in aircraft or commercial work, although its greatest use will no doubt be for broadcast receivers. Single knob tuning over the whole broadcast band, including the long waves without switching, is a particularly attractive feature in itself.

Television

The B.B.C.'s Autocratic Attitude

ENOUGH has been said in recent issues of *The Wireless World* to make it clear that, although high-definition television is now an accomplished fact, we are yet a long way off the day when any high-definition system can be expected to give a "service" in this country. We cannot all live in the neighbourhood of Broadcasting House, whence the ultra-short wave transmissions will probably originate, and no local transmission of this nature can be regarded as a national service. The public, especially those already interested in television, were entitled to expect the continuance of the 30-line transmissions *at least* until a superior service was available.

In the statement which we published last week it was shown that the B.B.C. has expressed the view that it has some responsibility in the matter of encouraging the public to buy equipment which may become obsolescent. Here we agree, and might point out that this was a matter which *The Wireless World* stressed when the B.B.C. first began the 30-line transmissions. It is hardly the time now, however, to realise this responsibility when the encouragement has been given over so long a period and enthusiasts all over the country have acquired their equipment. If the B.B.C. feels it incumbent upon it to take to heart this question of responsibility for equipment the responsibility is greater now than ever.

A New Receiving

Single Control Tuning Over 200-2,000 Metres Without Switching or Ganging

By W. T. COCKING

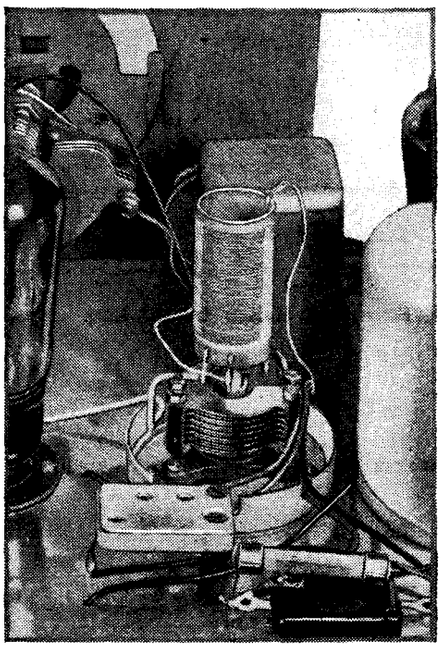
ONE of the greatest drawbacks of ordinary receivers is the ganging of the various tuning controls, for such a high degree of accuracy of matching in coils and condensers is required for a high standard of performance that components become costly and easily damaged. The initial adjustments, moreover, require to be performed with precision. All these disadvantages are removed at one stroke by a new receiving system, which will be known as single-span tuning, developed by "The Wireless World" and described for the first time in this article.

IN the past all receivers with any pretensions to selectivity have embodied several tuned circuits which required adjustment for every different wavelength. In the earliest sets each tuned circuit was separately controlled, but the difficulties of handling such a set soon led to attempts to link the various controls together mechanically so that they might all be operated by a single knob. A considerable measure of success has attended these efforts, and ganged receivers are now the rule rather than the exception. The components used in such a set, however, must be made with a high degree of accuracy, and coils and condensers must be matched within very close limits. A natural consequence of this is that the components become bulky and expensive.

Of even greater importance, however, is the question of the initial adjustments which are necessary when putting a new receiver into operation. Although these are not essentially difficult, troubles are often experienced because some component fails to come up to the requisite accuracy of matching, due, perhaps, to it having received careless handling at some time in its life.

A receiver in which no ganging is required and yet has only a single tuning control would remove all these difficulties at one stroke, but seems too good to be true. A receiver, moreover, which will tune over the full wave-range of 200 to 2,000 metres without necessitating any switching is the set of one's dreams, for it removes once and for all the bugbear of poor switch contacts.

These features and many others are obtained in the new receiving system developed by *The Wireless World*, and a skeleton circuit diagram showing the essentials appears in Fig. 1. The receiver is a superheterodyne, but differs from all other superheterodynes in having no signal-frequency tuned circuits. The oscillator condenser only is varied for tuning, and this is the only tuning control.



Air-cored coils of low-loss construction with air-dielectric trimming condensers are used in the I.F. circuits.

Experience with ordinary superheterodynes would lead one to believe that such a system would be useless on account of second channel interference, and this would indeed be the case if a normal value of intermediate frequency were used. Instead of a frequency of 110 kc/s, however, an intermediate frequency of 1,600 kc/s, or even higher, is used in the new system, and leads to many important differences, in particular the possibility of covering a very wide waveband with a small tuning capacity.

Broadcasting stations lie between the

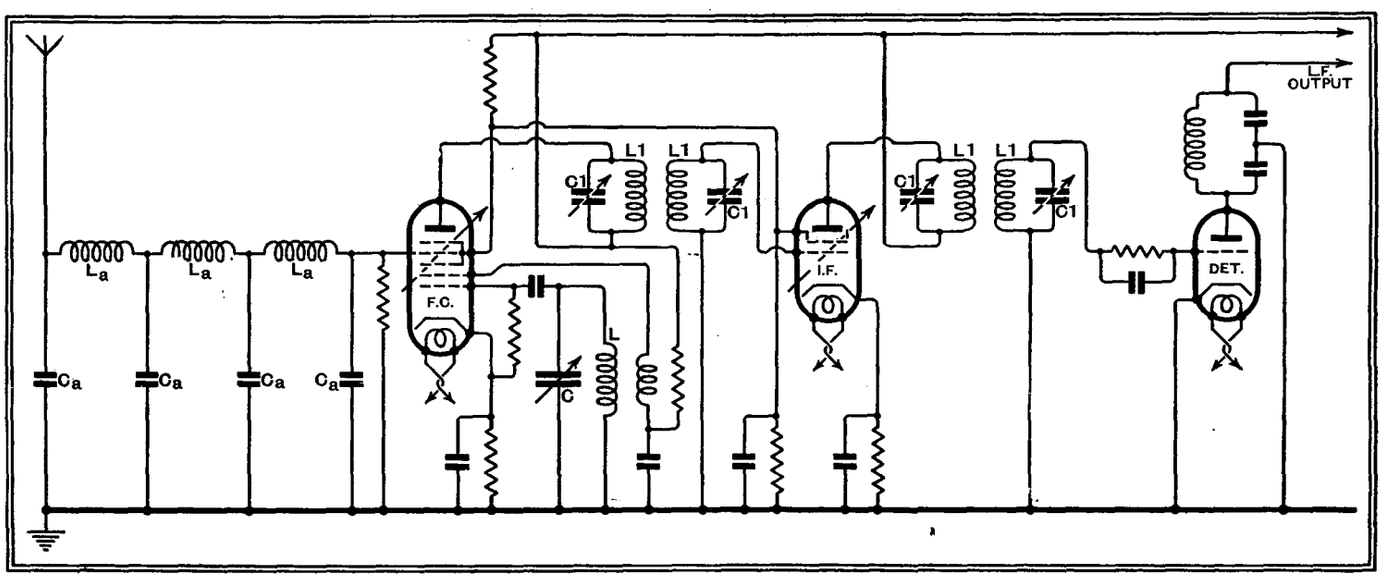


Fig. 1.—A skeleton diagram showing the essentials of the new receiver. The aerial circuit is aperiodic over the 200-2,000 metres band, but rejects signals of lower wavelength. A very high intermediate frequency is used, and as a result the full band can be covered by the oscillator tuning condenser C.

System

extreme wavelengths of 200 and 2,000 metres, or 1,500 kc/s and 150 kc/s, so that a frequency range of 10-1 must be covered. To do this in a single step with ordinary arrangements would mean a circuit in which the capacity could be varied over a 100-1 ratio, and a variable condenser with a capacity of some 0.005 mfd. would be needed! If we use a superheterodyne with an intermediate frequency of 1,600 kc/s, however, the oscillator can cover a much smaller range. For the reception of a station on 1,500 kc/s, the oscillator would work at 3,100 kc/s, and for a station on 150 kc/s at 1,750 kc/s. The oscillator need cover only the band of 3,100-1,750 kc/s, therefore, and for this a capacity change of only 3.14-1 is needed! It is, in fact, possible to use a short-wave type variable condenser of 160 mmfd. capacity and cover the range with ease. So far as the oscillator circuit is concerned, the problem of covering a wide range without switching is thus solved by using a high intermediate frequency.

The problem of the signal-frequency tuning is solved in a drastic fashion by not using any such circuits. Owing to the high intermediate frequency, second channel interference from a station in the 200-2,000 metres band is an impossibility. The only possibility of second channel interference comes from a station on a frequency 3,200 kc/s higher than that of the received signal. Second channel interference, therefore, can only be caused by stations between 4,700 kc/s and 3,350 kc/s, or 63.8 and 89.5 metres. These frequencies are so widely removed from those of the desired receiving range that it is a simple matter to design a fixed aerial coupling system which will pass frequencies between 1,500-150 kc/s and reject all others.

The Aerial Coupling

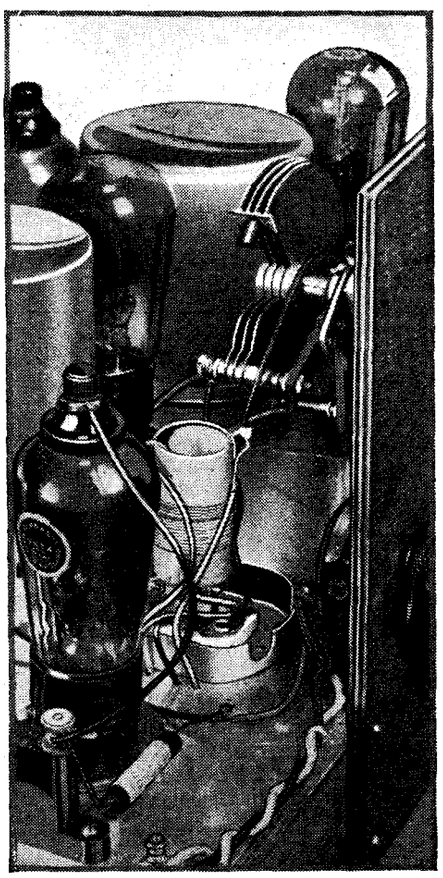
One particular aerial coupling is shown by the coils La and condensers Ca of Fig. 1. These constitute a low-pass filter and effectively prevent second channel interference. Other methods are available and the one shown here is not necessarily the best from all points of view.

It will be seen that all signals in the broadcast band are applied simultaneously to the tetrode control grid of the Heptode frequency-changer. It is, therefore, essential that this valve has essentially linear characteristics, otherwise cross-modulation by powerful stations would cause serious interference. In practice, however, no trouble has been experienced on this score.

The circuit diagram of the rest of the set shows no abnormality, save that a single small coil L is used for the oscillator and is tuned by a small condenser C, which forms the only tuning control. The I.F. amplifier can follow standard practice except that the circuits L1C1 are tuned to 1,600 kc/s instead of the usual 110 kc/s. Although no changes are essential in this part of the apparatus, they may be advisable, and the most successful of the receivers which have been used in the experiments have embodied an unusual form of I.F. amplifier. Full details of this will be given in a later article, and it will suffice to say here that it includes variable selectivity. This is an important point, since it enables the selectivity to be varied in order to suit the particular conditions of interference pertaining to the desired station. It is thus always possible to obtain the highest standard of quality of reproduction that interference will permit.

Features of the New Development

200-2,000 metres tuning range without gaps or switching. Single control tuning without ganging. No matched coils or condensers. No second channel interference or other whistles. Variable adjacent channel selectivity. No signal-frequency tuned circuits.



The tuning system of the new set consists of only one small coil with a S.W. type variable condenser.

It will be seen, therefore, that the new system is unique in that the aerial system is aperiodic over the 200-2,000 metres range and that frequency-changing produces an intermediate frequency which is higher than the incoming signals instead of lower. As a result, a very wide range of wavelengths can be covered by a very small capacity condenser, and as all tuning is carried out by the oscillator condenser, the need for ganging is entirely eliminated. The initial adjustments in a receiver of this type, therefore, are confined to lining up the I.F. amplifier, an extremely easy process. Not the least of the advantages of the system, however, lies in the avoidance of matched coils, for this means that the construction of the various coils comes well within the capabilities of the amateur, since elaborate apparatus for matching is unnecessary.

Selectivity

Before concluding this article it may be as well to make some mention of what at first might seem to be a failing of the method. The ordinary superheterodyne was developed largely because it presented the easiest way of obtaining high selectivity, since a tuned circuit operating at a low frequency is inherently more selective than one working at a high frequency. By changing the signal frequency to a lower value, therefore, a considerable gain in selectivity was obtained. With the new system, however, the signal frequency is changed to a higher value, so that one would expect a deterioration in selectivity. This would indeed be the case if selectivity were dependent only on the operating frequency. It is, however, also controlled by the number and efficiency of the tuned circuits, and experience has shown that by correct design it is not difficult to obtain adequate selectivity for present-day needs at a high intermediate frequency.

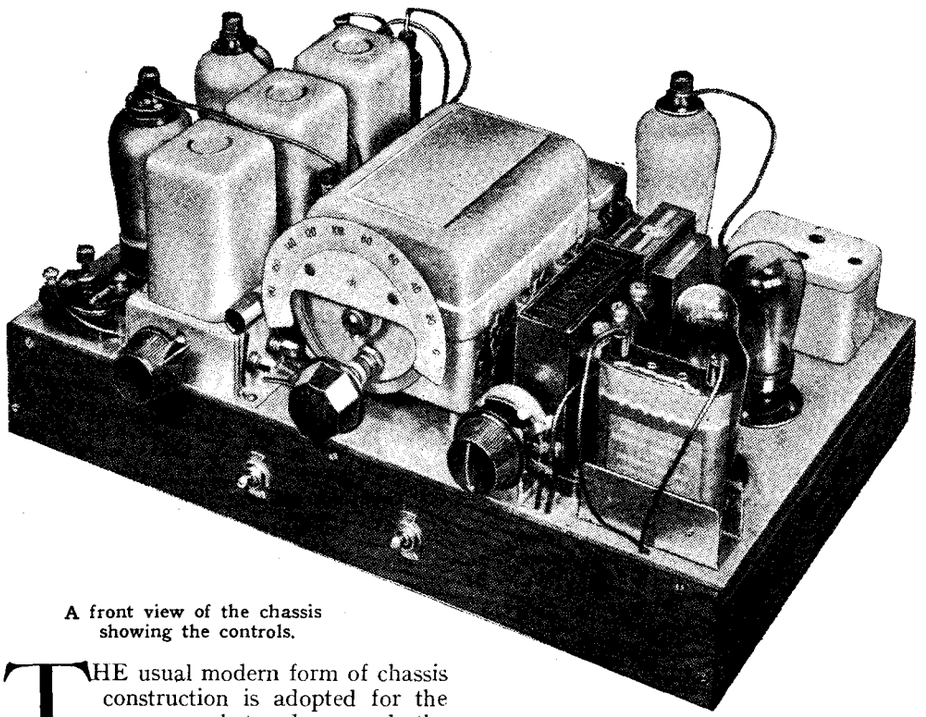
To sum up, the new receiving system offers important advantages over the customary methods in regard to the absence of waveband switching, the wide waveband which can be covered, the absence of any ganging, the ease of construction of the coils, the absence of second channel interference or other whistles, the ease with which variable selectivity may be obtained and the consequent improvement in quality of reproduction.

The illustrations to this article show some of the details of one of the experimental receivers used in the development of the new principle and one which proved capable of giving a highly satisfactory performance. It is intended to give constructional details of a set of this nature in the near future, and an announcement concerning this will appear in a later issue. The technical considerations involved in the application of the system will be dealt with next week.

The Everyman Battery Super

Constructional Details and Initial Adjustments

(Concluded from last issue)



A front view of the chassis showing the controls.

THE design of the new superheterodyne was discussed in last week's issue of "The Wireless World," and in this article will be found constructional details and operating notes, while full details of the initial adjustments are also given. It will be remembered that the set includes H.F. pentodes, a Heptode frequency-changer and a Class "B" output stage.

THE usual modern form of chassis construction is adopted for the new superheterodyne and the chief components are assembled on the upper side of the metal-covered base while the small parts and wiring are placed on the under side. No special order of assembly is necessary, but it is most convenient to leave the gang condenser to the last, since it is difficult to reach the coil terminals with this component in place.

Before mounting the condenser, therefore, all connections should be made to the terminals on the coils. There are three connections from these coil terminals to the gang condenser, so three wires should be attached to the appropriate terminals; the condenser can then be screwed down and these three wires soldered to the tags provided on it for the connections to the fixed plates. It should be noted that the connection to the moving vanes is made by the contact of the condenser frame with the metal-covered chassis. Care should be taken, therefore, to see that the fixing screws are well tightened.

Most of the small components are mounted under the base, and are placed in position while wiring. The grid condenser C4, however, of the Heptode is carried between the coils and the gang condenser by the wiring, and is supported vertically by a short lead from one of the coil terminals. Two leads are taken from the upper terminal of the condenser—one to the Heptode grid and the other through the base to R2.

The speaker used with the receiver should be fitted with a Class "B" type transformer of such ratio that the load impedance on the output valve is about 12,000 ohms. If this exact value cannot be obtained for any reason, the load should be higher rather than lower.

The only adjustments required on setting up the receiver are to the ganging and the I.F. circuits. A delay voltage of 4½ volts should be used on the A.V.C. system, and the bias on the driver and output valves should also be 4½ volts, while 1.5 volts should be used for the initial bias of the early stages. At the start, the two coupling screws on the I.F. transformers should be screwed up tight.

A station should be tuned in, and each of the four I.F. trimmers adjusted for maximum signal strength. If the station is a weak one, this will correspond to maximum volume, but if it be strong there will be little or no change of volume on account of the action of A.V.C. On a strong signal aural methods of determining the optimum trimmer settings are of little avail, although fair results may be obtained by trimming for the deepest toned reproduction. For the best results, however, a milliammeter should be connected in the anode circuit of one of the first three valves and trimming carried out for minimum reading on the meter.

The next step is to loosen the coupling as much as possible without losing the signal, and then to re-trim. The couplings can then be finally adjusted for the best quality of reproduction. The tighter the couplings used, the better will be the quality and the higher the sensitivity, but the lower will be the selectivity, so that some compromise is necessary. The adjustments, however, are by no means critical.

Having completed the I.F. trimming, the signal-frequency circuits must next receive attention. First roughly adjust the trimmers on the aerial and H.F. transformer sections of the gang condenser for maximum signal strength as determined either by maximum volume or by minimum current on the meter. Then tune in a station on as low a wavelength as possible, certainly below 250 metres, and repeat the adjustment. If a definite optimum setting for each trimmer can be secured, well and good, but if one trimmer has to be fully unscrewed, the oscillator trimmer should be screwed up slightly and the station retuned at a slightly lower dial setting, so that the other trimmers can be more accurately set.

The Importance of Ganging

When satisfactory settings have been found, tune in a station at the other end of the scale, and adjust the oscillator trimmer while rocking the condenser dial backwards and forwards over a few degrees until the optimum combination of settings be found. Then go back to the low wavelength station and readjust the two pre-selector trimmers.

When accurate medium wave ganging has been secured, it is the turn for the long waveband. Here the only adjustment necessary is to the padding condenser C6. A station at the upper end of the band should be tuned in, and the condenser adjusted while rocking the gang condenser backwards and forwards over a

A specimen receiver built to the specification described in this article is available for inspection by readers at 116, Fleet Street, E.C.4.

The Everyman Battery Super—

few degrees until the optimum combination of settings is found.

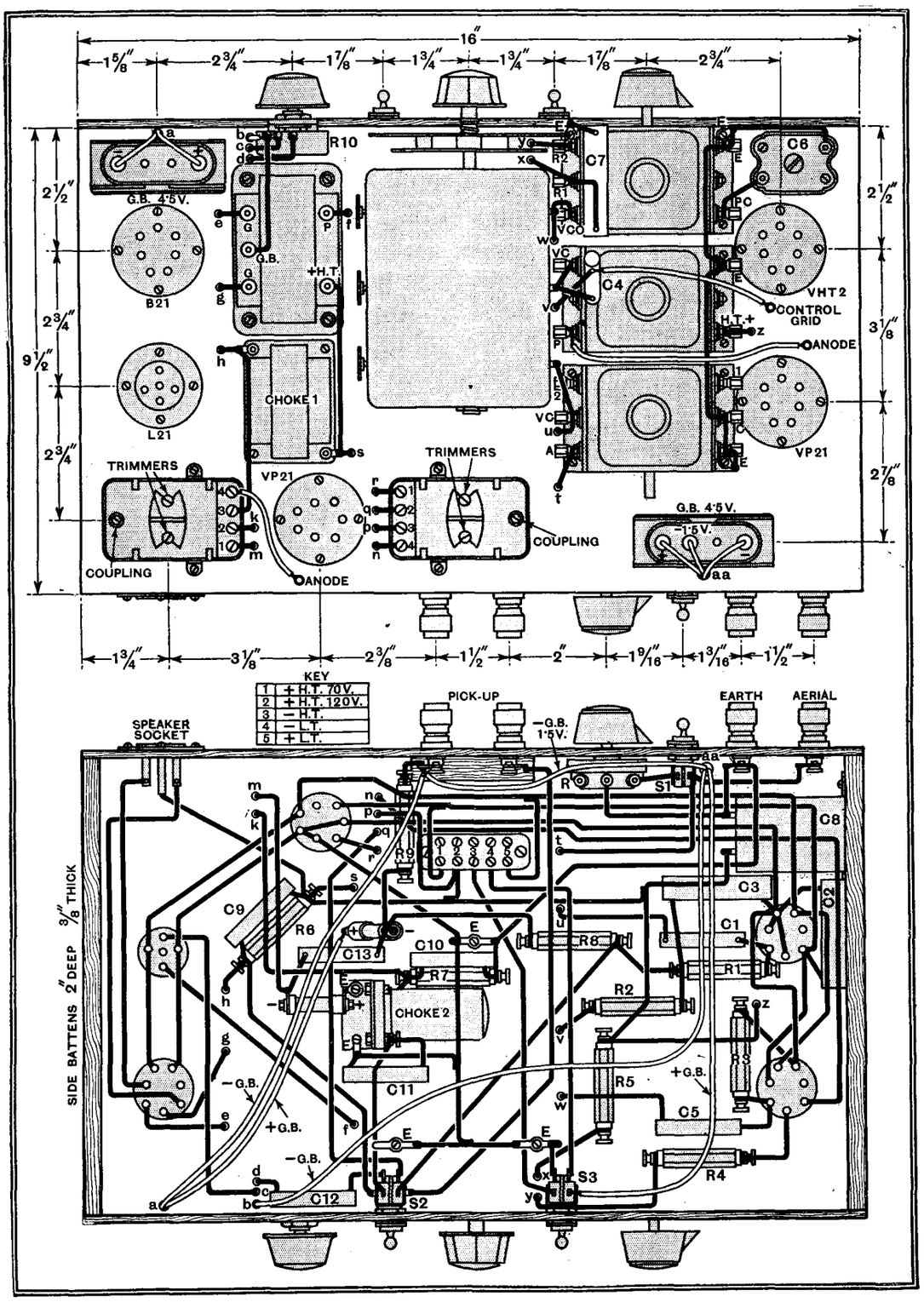
The initial adjustments are now completed and it should be possible to tune in stations over the whole of the waveband, and if A.V.C. is functioning correctly they should all be received at substantially the same strength, except, of course, in the case of very weak stations and the locals. Throughout the process of adjusting the set, the local-distance switch should be kept at distance, that is, with S1 open. For the reception of a local station, it will be necessary to close S1, in order to avoid distortion, and the resistance R must be adjusted to the correct value. Starting from maximum, reproduction will be at first distorted, but as the resistance is decreased the quality will become better, and the volume probably somewhat greater. After a certain point, however, the volume will start to decrease. The optimum setting is with R a little higher than this critical value.

A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d. post free.

Used under average conditions the set should be free from whistles due to second channel and kindred forms of interference. Where the set is used near a local station, however, it is to be expected that a second channel whistle will occur, since two signal-frequency circuits do not offer sufficient protection against this severe condition. Unless the aerial is very efficient or the local station very close, other whistles due to harmonic generation in early valves should not appear. In this connection, however, it may be pointed out that such whistles are more likely to be present than in the case of a mains-operated set, simply because battery-type valves are incapable of handling such a large input as the mains types. Fortunately, the remedy is easy in those few cases where, due to particular local conditions, whistles do occur. They may be completely removed by the use of the special wavetrap-type of second-channel eliminator described in *The Wireless World* for January 26th, 1934.

The receiver has been tested in London on a good outdoor aerial and gave a very good account of itself. The sensitivity and selectivity both proved of a high order, and sufficient for all ordinary purposes, while the quality of reproduction was very satisfactory. Using a sensitivity type of loud speaker, the volume proved adequate for most domestic requirements. In these days of sensitive and selective receivers, a list of stations receivable conveys little or nothing, and it is sufficient to say, therefore, that the set proved capable of receiving any station spaced from its neighbours by the usual 9 kc/s with good quality, provided that the trans-

PRACTICAL WIRING DIAGRAM



The wiring diagrams of the superheterodyne, from which the straightforward layout is apparent.

The Everyman Battery Super—

mission was itself good and that the station was appreciably stronger than the prevailing background of atmospherics and man-made static. The only exceptions were in the case of stations immediately adjacent to the locals, but the spread of these was confined to an extremely small degree, and caused interference with very few stations indeed.

So far no mention has been made of the two condensers C14 and C15 which are shown dotted on the circuit diagram. These condensers are not usually needed and where they are not it is better to leave them out. In a few cases, however, parasitic oscillation of the output valve may be found, due to the characteristics of the particular components and valves used. The symptoms of parasitic oscillation are poor quality and an abnormally high quiescent anode current for the Class "B" valve, and the trouble can be cured by inserting the two condensers C14 and C15. When using these condensers, it may be found necessary to increase the coupling of the I.F. transformers slightly to maintain the normal high-note response.

Good gramophone reproduction should easily be secured and it should be noted that the manual volume control functions both on radio and gramophone. It is possible that some break through of radio on gramophone may be found if S1 be left at distance, so that a habit should be made of closing this switch and mistuning the set from a local when reproducing records.

DISTANT RECEPTION NOTES

A Record Heterodyne : Limiting Modulation

MY best thanks to the many readers who have written to me about the reception of Heilsberg. They prove beyond all question that the truth is as I expected: Heilsberg can often be heard clear of interference during the afternoon or early evening, but from about seven o'clock onwards the transmission is badly interfered with by a station which is probably Leningrad No. 2. Parede, the new Portuguese station, is supposed to share Heilsberg's wavelength, but is not doing so at the moment.

It is good news to hear that the Spanish authorities have introduced legislation to bring broadcasting entirely under Government control. The proposed scheme is not unlike the French PTT plan, and something of the kind was very badly needed, for the privately owned Spanish stations have been doing pretty well what they liked in the way of wavelength wandering. Both the Spanish and French Governments have decided to eliminate advertising from the programmes of State stations as soon as possible.

There is a particularly interesting heterodyne occurring at the present time. The reader may find it difficult to believe that any heterodyne can be interesting, but when he knows the cause I think he will admit that this one is. The station concerned is Hilversum, which has suffered from a poisonous whistle late in the evening from the very first day of the Lucerne Plan. Some nights ago when using an experimental receiver designed for selectivity beyond everything else I was rather surprised to pick up the call-sign of WBZ just after 10 p.m. Hilversum's frequency is 995 kc/s. That of WBZ, the 50-kilowatt U.S.A. station at Springfield, Massachusetts, is 990. There is thus only a 5-kilocycle separation between their carriers and the heterodyne is there.

I cannot guarantee that it is always caused by WBZ, but it certainly was on the night in question. Since the great circle distance between the two stations is well over three thousand miles, this must be something like a record in heterodynes. Does the reader now agree that it is an interesting one?

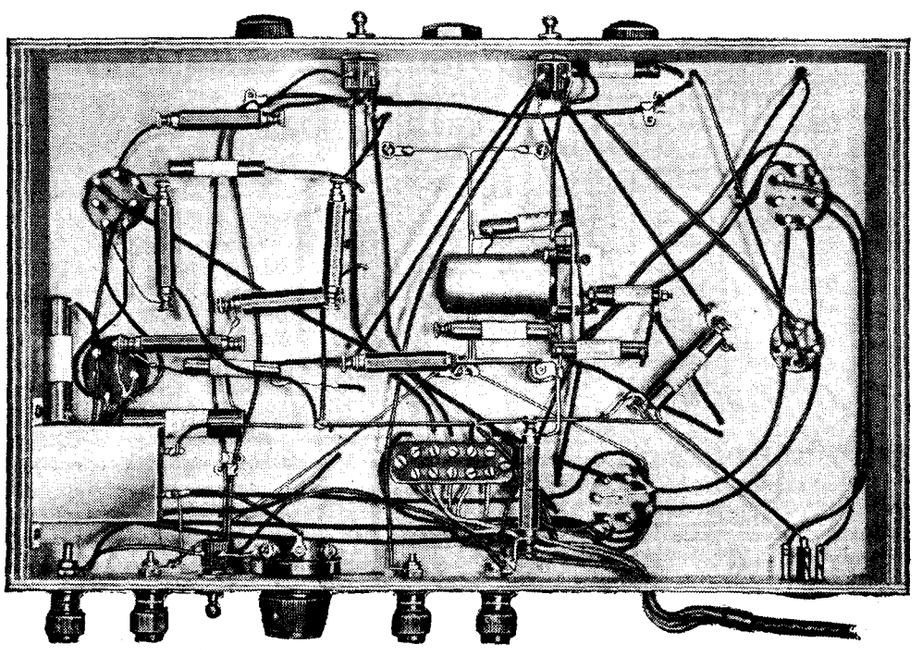
Further, I strongly suspect other American stations, such as WPG, WCAU, WHAM, and WTIC, of being guilty of interference with other stations. I am beginning to think that many of the transmissions marked with a query in the U.I.R. Reports hail not from Europe, but from the other side of the Atlantic. If and when the two American stations which are now using 400 and 500 kilowatts respectively for experimental purposes are allowed this output power during programme hours, the possibilities are distinctly alarming. One foresees the time when not merely a Lucerne Plan for Europe, but a London, or New York, or Tokio Plan for the whole world will be required!

Long before the Lucerne Plan came into operation I suggested that one of the greatest needs of the future would be a strict limitation of the permissible depth of modulation. There *is* a clause about modulation in the Lucerne Agreement, but a good many European stations do not appear to be observing it very strictly. Some of the French stations were always rather bad offenders in the matter of over-modulation, and they do not yet appear to have seen the error of their ways. The trouble about over-modulation is that it defeats even the most selective of receiving sets.

Whilst the long-wave position is still not too good, it has been cleared up to some extent by the removal of Leningrad No. 1 to the intermediate waveband. The Russian station was at one time trying, with rather disastrous results, to elbow its way in between those excellent transmissions, Oslo and Kalundborg. Both of these are now clear of interference. Zeesen, Warsaw, Motala, and Luxembourg are also generally well received.

The choice of stations on the medium waveband is becoming steadily wider. Barcelona is still spoiling Leipzig, and Radio LL frequently causes trouble with Berlin. With these exceptions, however, there are few stations with individual wavelengths above 300 metres which are not well received.

D. EXER.



The underbase view of the "Everyman Battery Super," showing the disposition of the components.

FOREIGN BROADCAST GUIDE

HAMBURG

(Germany).

Geographical position: 53° 30′ N.; 10° 0′ E.

Approximate airline from London: 450 miles.

Wavelength: 331.9 metres. Frequency: 904 kc/s. Power: 100 kW.

Standard time: Central European (Greenwich mean time *plus* one hour).

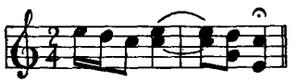
Standard Daily Transmissions:

G.M.T.: 05.00 (Sun. 08.00) time, weather, news, etc.; 05.15 (ex. Sun.), physical exercises; 05.35, concert; (Sun. 08.15); 10.00 (Wed.), English lesson; transmits continuously until 18.00, when National broadcast is given (S.B. to all German stations); 19.00, main evening programme; 21.00, time, weather, news, etc.; occasionally given dance music. Closes down at approx. 23.00 (Sat. 00.00).

Announcers: Man and woman.

Call: *Hier Hamburg und Sendergruppe Nord.*

Interval signal: Short musical phrase as under:



Closes down with good-night greetings, followed by *Horst Wessel Lied* (Nazi Hymn).

Relays: Bremen, Magdeburg, Stettin, Hanover and Flensburg on 225.6 metres (1,330 kc/s.).

In Support of High Power

A Reply to the Plea for Reduction

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

IT is very unlikely that any readers of the article by Mr. Hallows in last week's issue can reasonably deny his contention in regard to the present situation in reception that, since the general increase in transmitter power, difficulties have increased, not only for simple types of receivers, but even for the much more complicated and sensitive ones now generally available. Because these two things—transmitter power and receiver difficulties—have increased together, Mr. Hallows goes on to conclude that they are therefore related as cause and effect. His remedy, logically enough, is to restrain the power which he sees to be the cause of the trouble.

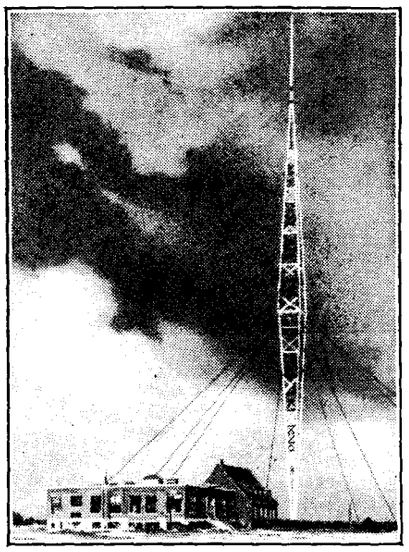
This attitude may be likened to that of a gardener, who, observing that his growing plants begin to overlap and interfere with one another, would overcome the difficulty by arresting their growth. To those who, like the Japanese, appreciate the merits of stunted growths, this plan might commend itself; but the custom in most places is to prefer full-size plants. In the same way there are those who like high-power stations; if there had been no demand, presumably there would have been no supply.

A reduction of power at the transmitting end necessarily requires an increase in receptivity, at some stage or another, of the receiving system, if the received volume is to remain undiminished. Assuming that sources of local electrical interference would not be obligingly abated in the same proportion, it follows that receivers would be more susceptible to the interference; and that an all-round reduction in transmitter power to the 1926 standard would greatly increase the use of reaction in receiving sets and so multiply the task of the Post Office anti-interference department, unless very many of the six million licences lapsed altogether as a result of the changed conditions in broadcasting.

IN last week's issue we published an article by Mr. R. W. Hallows under the title "Is High Power a Boon?" Now we include a reply in opposition to the views expressed in that contribution and stating a case for the high-power policy.

Considering for the moment electrical machine and other local interference, and not that caused by other broadcasting stations, it is obvious that the greater the power the better. If you are in a room where a lot of people are talking, and also there is a rattle of cutlery and crockery, assuming the latter to remain at constant strength, your chances of overhearing the conversations clearly increase if all the people raise their voices.

Again, a uniform all-round increase in power cannot in itself necessitate increased sensitivity at the receiving end, but precisely the reverse. If what Mr. Hallows says is true, that more sensitive receivers are in actual fact required to meet present conditions, it must be for some other reason. People who got into difficulties because of a large increase in power on the part of the local station were able to put themselves in order, *so far as that station was concerned,* by shortening the aerial or in some other way desensitising the receiver. Increase in power, then, enables a less sensitive, and therefore potentially simpler, type of receiver to be used.



500 kW. BROADCASTER. The station buildings and 830ft. vertical aerial of the Crosley Radio Corporation's transmitter WLW in Cincinnati, U.S.A., the most recent addition to America's broadcasting network.

But, you may say, what about the other stations that this listener used to hear? A fair comparison can be made only if they have all gone up in power in the same proportion as the local station. In those circumstances reception with the less sensitive receiver should be as before. In no way, then, has an increase in power worked to our disadvantage; on the contrary, it has made possible a reduction in sensitivity, with a corresponding reduction in background noises due to local disturbance.

Then what is the cause of all the ills that have befallen us? Mr. Hallows himself supplies the clue when he deals with the selectivity question—"Even when only two of the regional stations were at work many receiving sets were so completely swamped that they could not separate the twin transmissions."

Exactly! Two blades of grass appear where one grew before. That reminds us of our contemplative gardener, who, if he has been well trained, does a bit of thinning out and transplanting. For, to make the analogy sound, it must be supposed that not only are the original plants spreading themselves out but also many others are pushing up through the soil. In such circumstances no reasonable restrictions on growth are likely to ensure room for every plant.

In the golden age of reception, when Mr. Hallows received every little relay station on a three-valve set, there were only about half of the present number of stations. Of course, one must expect to have greater difficulty in receiving those stations which have not kept pace with the race for power, even apart from the numerical increase. But if the stations are more numerous it is necessary to weaken the coupling from the aerial, or shorten the aerial, in the interests of selectivity, and make up for the loss by increasing the amplification of the receiver itself. More tuned circuits are needed, more valves in between them, and—hey presto! the modern complicated set!

A Changed Outlook

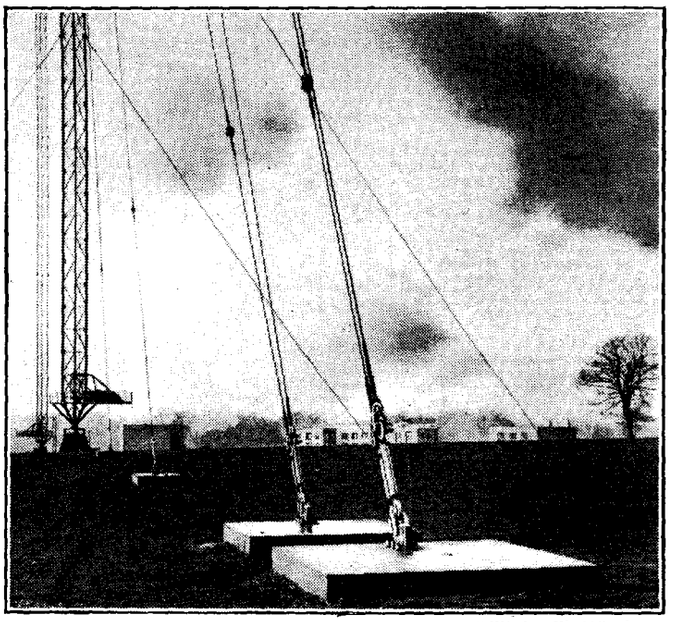
There are some other reasons to account for this state of affairs. It is very unlikely that the "full loud-speaker strength" of 1926 would be recognised as such to-day. Then the receiver of that date depended for its long range on very extreme and expert use of reaction, without any attempt at tone correction; not even a pentode! There was far too much poor quality due to side-band cutting for side-band splash to be serious.

Aerials were long and high and carefully arranged, coils large and efficient, and many other details much more "low-loss" than at present, now that higher power transmissions have rendered these things less necessary. Even so, the best receivers of the time were quite unable to bring in as many stations at entertainment strength during daylight as under present conditions. One used to be practically limited to a hundred miles or thereabouts.

What is the cure for the admitted difficulties of the present situation? Any overall reduction in power, without reduction in number, would *not* help matters.

In Support of High Power—

"The listener owning a small set unprovided with automatic volume control" already experiences "substantially the same signal strength at all times from his local station," so he has no worries in that regard; but he probably would have if Mr. Hallows' scheme for daily and seasonal variations were carried into effect. On the other hand, no system of power reduction would enable the stable conditions of daylight reception to be repeated during periods of darkness. And if the service areas of stations, as defined, were restricted to their immediate neighbourhoods, what about the foreign listening that we are all agreed has become more popular—and is really worth while.



"Wireless World" photo.

Massive concrete blocks anchor the supports to the 700ft. masts of the new B.B.C. high-power station at Droitwich.

The ideal solution to the problem would be to abolish about 80 per cent. of the European stations, or put them on to short waves. The remaining ones would then be spaced uniformly at least 20 kilocycles apart. The frequencies would be allocated according to the area to be covered; the lower frequencies travel a greater distance before the reflected wave upsets reception by causing fading and night distortion. For the same reason these would be the transmitters of highest power. Corresponding to each frequency there is a certain radius beyond which fading is probable, and no increase in power beyond that which gives effective reception at this limit is of any avail to ensure really satisfactory results beyond it. On the other hand, a lower power is a waste of a frequency channel, because it does not effectively fill its area. Therefore we would have all the stations arranged in order of decreasing service area, increasing frequency (decreasing wavelength), and decreasing power. This, incidentally, would eliminate the vast amount of heterodyning caused by a multiplicity of stations too weak, relative to the general standard of power, to allow of effective distant reception; yet enough to cause whistles on other stations.

Further to counteract the disturbing effects of the reflected ray, which causes irregular reception and interference by distant stations, the design of aerials for restricting radiation to the ground ray should be more energetically pursued.

Perhaps when the people concerned have finished their present job of bringing Disarmament into force, they might care to tackle a *really* difficult international task: that of implementing the foregoing recommendations.

What's New in German Radio

A Visit to the Leipzig Fair

By a Correspondent

PUBLIC taste in Germany has definitely veered round from bakelite to wood in the manufacture of radio cabinets. This is one of the more obvious conclusions to be drawn from the radio section of the Leipzig Fair, which was opened last week by Dr. Goebbels, Minister of Propaganda.

The most important group of radio firms in Germany, the A.E.G., Siemens and Telefunken, exhibited their three-valve superhet. in a wooden cabinet. Selectivity has claimed the efforts of research specialists during the past year. The Tefag firm, who were showing a four-valve superhet. for the first time, claimed for it a degree of selectivity of 1 to 450; in other words, the field strength of a neighbouring station can be 450 times that of a station being received before any interference becomes apparent, providing that the wavelength separation is the regulation 9 kc/s.

Increased efficiency in loud-speakers is in part due to the fact that the Government broadcasts are now listened to in factories and shops. Telefunken, Grawor and Dr. Dietz and Ritter are three of the firms which have developed new apparatus to meet this demand. The last-named firm claims to have produced the "world's most powerful moving-coil loud speaker," which requires a special amplifier of from 40 to 60 watts output.

A large number of receivers at Leipzig were fitted with the new *keramik* insulating material. This is extremely low loss and is said to make for high selectivity and greater compactness of apparatus.

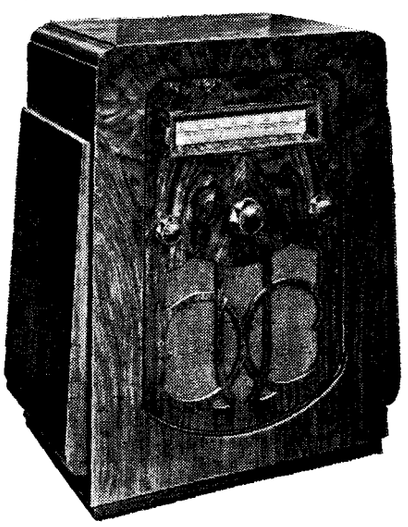
A "valve truce" has been proclaimed by the radio manufacturers in Germany, which means that set constructors can now go ahead with designs for the next radio show with the full assurance that no modifications will be rendered necessary by the unwanted introduction of new valves. It seems likely, therefore, that there will be no startling receiver developments in Germany during 1934. Any new types of valves will probably be for export only.

Anti-interference gadgets were well to the fore, and one firm has gone so far as to produce a handy "first aid" outfit for the service man who is seeking to track and eliminate crackles. Anti-interference aerial down leads were on view as complete kits for home assembly.

Telsen "474" Receiver

A Band-pass Three-stage Mains Set for Less Than £10

IN appearance the chassis of this new Telsen receiver is similar to that of the Model "464," reviewed on October 27th last, but important alterations have been made in the circuit and the new cabinet is of unusually attractive design and finish.



The Telsen Model "474" receiver in the latest design of cabinet.

There is now a band-pass input circuit using iron-cored coils and a differential condenser in the aerial lead is used as a volume control. A marked improvement in selectivity is noticeable, especially in the middle and upper sections of the medium waveband. Any loss of sensitivity due to the introduction of the band-pass circuit has been amply compensated for by the use of H.T. pentodes, both in the H.F. and detector stages, while a more sensitive pentode in the output stage has been combined with resistance coupling instead of the transformer in the Model "464."

At 9½ guineas this set is excellent value for money, and will give all the average listener demands in entertainment value.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

Adding A.V.C.

THE introduction of the new low-capacity Westector (Type WX) makes the addition of A.V.C. to an existing set a much more practicable and attractive proposition than it has been in the past. Although the older type of H.F. metal rectifier could be fitted quite easily for the purpose of automatic control, its effectiveness fell off progressively with reductions in wavelength until, at the bottom of the medium broadcasting band, very little control was obtainable. That is just what we do not want, for the reason that fading is generally much more pronounced at the low wavelengths.

For these reasons the use of the Westector as an "add-on" A.V.C. device for existing sets has been hitherto largely confined to superheterodynes, where it has to deal, of course, with signals of a fixed and comparatively high wavelength. The new low-capacity rectifier, on the other hand, is definitely capable of working at wavelengths as low as 200 or 300 metres, and so it may be used as an A.V.C. device in "straight" sets. True, the voltage obtainable for control purposes will still be influenced by wavelength, not only because of the rectifier capacity, but for the reason that, in the conventional arrangement, H.F. impulses are fed to it from an H.F. choke.

It is worth while pointing out that this form of rectifier may be made to give delayed A.V.C. in a "straight" set in very much the same manner as in the "Everyman" series of superheterodynes. The basic circuit arrangement for this purpose is shown in Fig. 1, from which it will be seen that the delay voltage is obtained from a small dry battery, GB1, which may usually have a maximum voltage of $4\frac{1}{2}$ volts. Tappings should be provided, in order that the delay voltage may be set at a lower value if it is found desirable to do so.

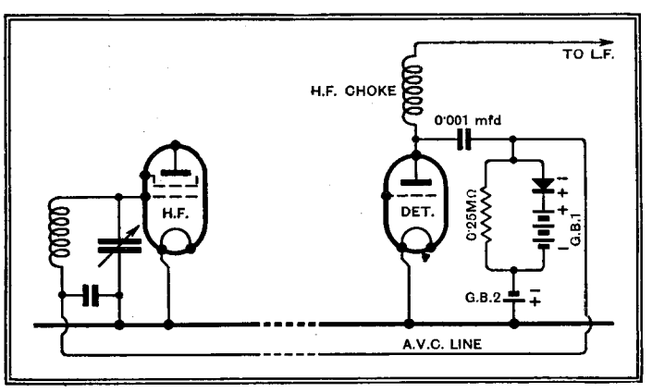


Fig. 1.—Skeleton diagram (with filtering omitted) showing the addition of A.V.C. to an existing receiver.

When dealing with battery valves, a "standing" bias may be applied to the "controlled" grids by connecting a single cell (GB2) in the manner indicated.

Loss of Magnification

THOSE who propose to fit a diode detector should never lose sight of the fact that it is not in any way an amplifying device. Therefore, the loss in sensitivity must be made good either by adding amplification before or after the process of detection.

With ordinary valves there is little choice left but to employ post-detection amplification. However, by taking advantage of the properties of the modern type of screened H.F. pentode, it is possible, if one of these valves is used in the H.F. (or I.F.) stage preceding the diode, to pass on a very considerable H.F. voltage without risk of introducing the troubles which would normally result from overloading.

A.C. or D.C. ?

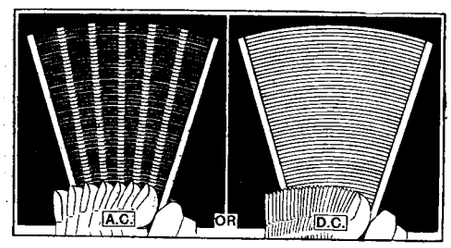
ALTHOUGH there are numerous well-known methods of ascertaining the character (A.C. or D.C.) of an electrical supply without the use of measuring instruments, it is probable that the only one requiring no apparatus at all is that which makes use of the principle akin to that of the stroboscope.

The method is to wave a rod in a horizontal plane under an electric lamp connected to the source of supply of which the nature is in doubt. When viewed under a lamp connected to a D.C. system the vibrating rod appears as a continuous blur, but with A.C. it has a striated appearance rather like the radiating ribs of a fan. The effect is shown more clearly than it can be described in the accompanying drawings.

Tests are most easily made when the lamps are of the ordinary metal-filament type, which cool rapidly between alternations of A.C. current. At a pinch, the index finger of the hand may be used, but the effect is most clearly seen with a thin rod or tube of bright metal, such as a screwdriver. The striations are most easily visible against a fairly dark background.

Which End ?

THIS paragraph is addressed solely to beginners, who, it would appear, are sometimes in doubt as to whether it is permissible to reverse the connections of the simpler type of component having but two terminals. So far as plain tuning coils, fixed condensers (not electrolytic), resistances, smoothing chokes, H.F. chokes, etc., are concerned, it is a matter of complete indifference how the components are connected in circuit. The same applies to on-off switches in nine cases out of ten, but in the tenth case it may be worth while going to the trouble of seeing that the terminal connected to the greatest mass of metal is on the "earthy" side of the circuit.



An electrical divining rod.

Pursuing the same idea, the frame and rotor—again the greatest mass of metal—of a variable condenser should always be on the earth side.

Parallel Condensers

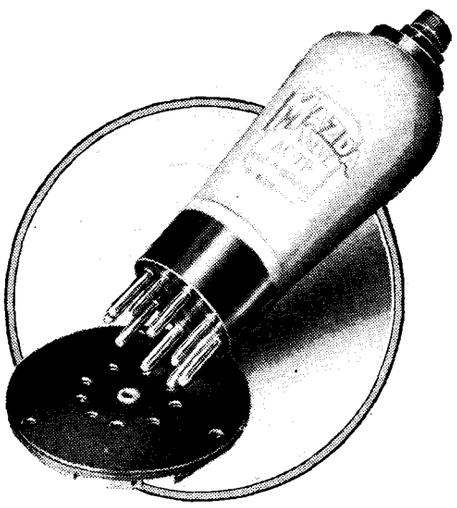
WHEN it is suggested that a decoupling or smoothing condenser should be replaced by one of higher capacity, it is not usually intended that the advice should be taken quite literally. For the benefit of those who have not completely realised that the capacity of condensers connected in parallel is additive, it may be pointed out that when a 2-mfd. condenser is to be replaced by one of 4 mfds., the existing component is not necessarily "scrapped." The usual procedure is to make up the desired value by connecting an extra 2-mfd. condenser across the component already in use.

Short Cut to Stability

WHEN a modern H.F. or I.F. amplifier oscillates uncontrollably, the easiest way of taming it is to increase the value of the automatic bias resistance to a value somewhat greater than that ordinarily recommended for the particular type of valve in use. If, however, it is found that a very considerable increase over and above the usual value becomes necessary, we have a certain indication that something is wrong; possibly the decoupling arrangements are inadequate, or else wiring has been carried out in such a way that there is an undesirable transference of energy from one circuit to another.

The Triode Pentode

A New Frequency-changer with Interesting Advantages



OF the various stages in a super-het the frequency-changer is probably the most complex and provides the greatest scope for development. Its function is to mix the incoming signal and a locally generated oscillation to form another frequency which can be amplified in selective circuits with comparatively simple apparatus.

Probably due to bitter experience with some early types of special single-valve frequency-changer, there are still a number of designers who favour the use of two valves for this stage and employ a triode as local oscillator and a tetrode or H.F. pentode as anode-bend first detector, usually injecting the voltage from the former into the cathode of the latter. Such arrangements work well, but in the march of progress the new single valves of multiple function which are now appearing on the market are finding favour, not only because they are less expensive, need fewer components and make for a more compact set, but because they may be more efficient electrically.

The conditions for perfect frequency changing are, unfortunately, rather exacting, and very few valves have been especially designed as detectors for a signal-frequency input and an I.F. output. A valve which is ideal for high-frequency work will probably not have the correctly shaped rectification characteristic as a first detector, and whistles or repeat points due to harmonics will appear. It has already been explained in this journal that the rectification curve should follow a square law. Some of the single-valve frequency-changers have a triode oscillator portion which has such a low mutual conductance that in order to produce adequate heterodyne volts, without inordinately close-coupling of reaction, the grid circuit has to be tuned rather than the anode. This may give rise to oscillator harmonics which again will cause whistles.

Another point to which more attention is now being paid is the development of the optimum heterodyne voltage over the tuning range.[1] Knowing the applied anode voltage and the characteristics of the oscillator valve, it is possible to calculate the degree of coupling of the reaction coil which will give the best input voltage to the first detector. Too often the frequency-changer valve and the oscillator coil are chosen at random—without reference to each other's requirements. Cases have come to light lately where heterodyne voltages of over 35 have been developed although the correct value should have been 3 or 4. A set in which the first detector is so grossly overloaded as this is bound to give disappointing results.

From the foregoing it will be seen that the desiderata for the ideal frequency-changer are that its first detector characteristics should be truly square law, the oscillator portion should possess sufficiently high mutual conductance and amplification factor to permit anode circuit tuning, and the valve should be supplied with full data for the design of the oscillator coil so that optimum heterodyne volts are developed over the waveband. In addition the conversion conductance (i.e., efficiency) should be high and should not vary unduly for the small changes in heterodyne volts which are bound to take place with change in tuning;

MAZDA AC/TP.	
Heater volts	4.0
Heater current (amps.)	1.25
Max. anode volts	250
Max. screen volts	250
Max. oscillator anode volts	200
Mutual conductance* pentode portion	3.4
Mutual conductance* triode portion	1.2
Conversion conductance (micromhos)	700–850
Optimum heterodyne (peak volts)	3–5

* *Taken at anode volts = 250, screen volts = 200, grid volts = 0.*

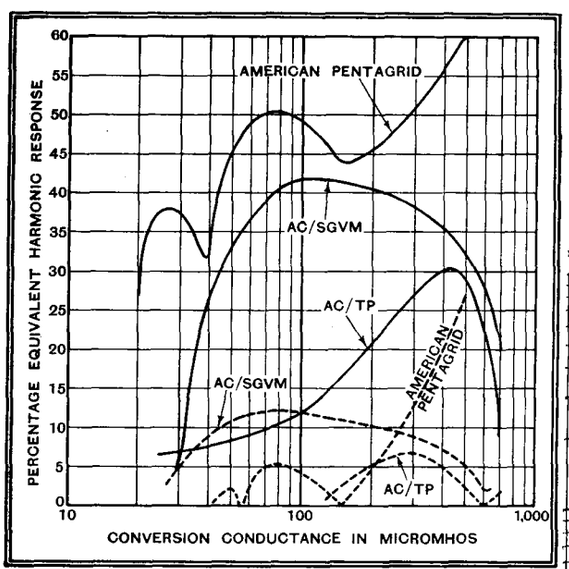


Fig. 1.—Showing the 2nd (full lines) and 3rd (dotted lines) harmonic responses of three typical frequency - changers. A harmonic response can be defined as being equivalent to a response produced by oscillator harmonics but introduced by the curvature of the characteristic.

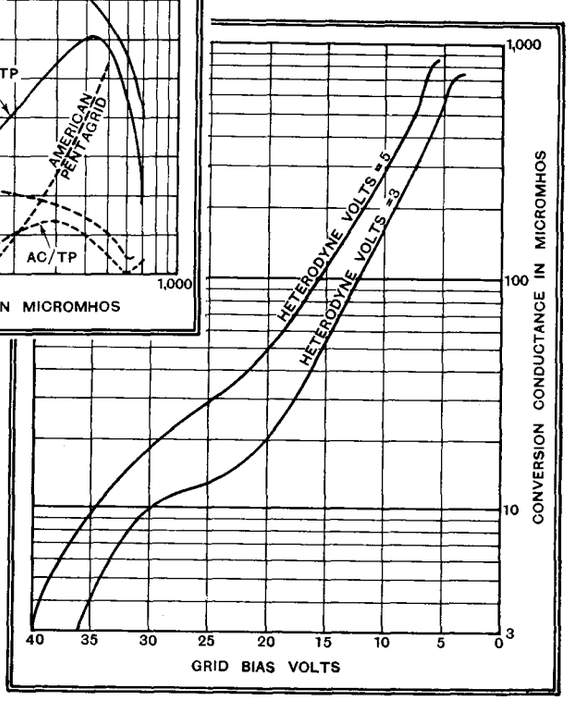
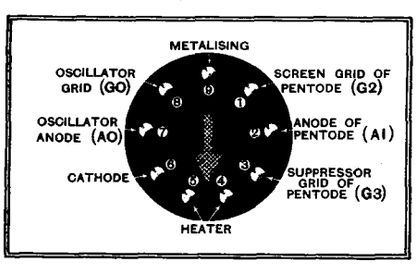


Fig. 2.—Change of conversion conductance with bias for two values of peak heterodyne volts. From these curves it will be seen that a small alteration of heterodyne volts is not accompanied by a serious change of conversion conductance.

[1] See article entitled "Conversion Conductance" in issue dated February 23rd, 1934.



Pin connections looking at the base of valve. The top cap is joined to the control grid of the variable-mu pentode (G1). Note the indicating arrow which facilitates the insertion of the valve into its socket.

The Triode Pentode—

the grid base should be long, say 40 volts, so that full A.V.C. control is possible without overloading, and valve noise must be as low as possible. Another point which is often overlooked is that with modern I.F. transformers, especially those with iron cores, selectivity and conversion gain will be impaired if the working anode impedance of the first detector is comparatively low.

A new frequency-changer has lately been introduced—the Mazda AC/TP—in which most of the common defects already enumerated have been overcome. It is a triode-pentode—that is, a triode and an H.F. pentode built in the same bulb and, unlike the pentagrid, electronic coupling is not used. Although only one apparent valve is used, it is of the double-type, and the frequency-changer is thus of the two-valve variety. The triode portion acts as an oscillator and the H.F. variable-mu pentode as a controlled first detector. The suppressor grid is brought out to a separate contact as well as the metallisation, thus necessitating a 9-pin base (see illustration) and top cap. The working impedance has the commendably high value of one megohm, so that the I.F. circuit is not unduly damped, and the gc^2/Ia ratio on which valve noise is chiefly dependent has been made high (gc is conversion conductance and Ia is anode current). The more important constants are given in the accompanying table.

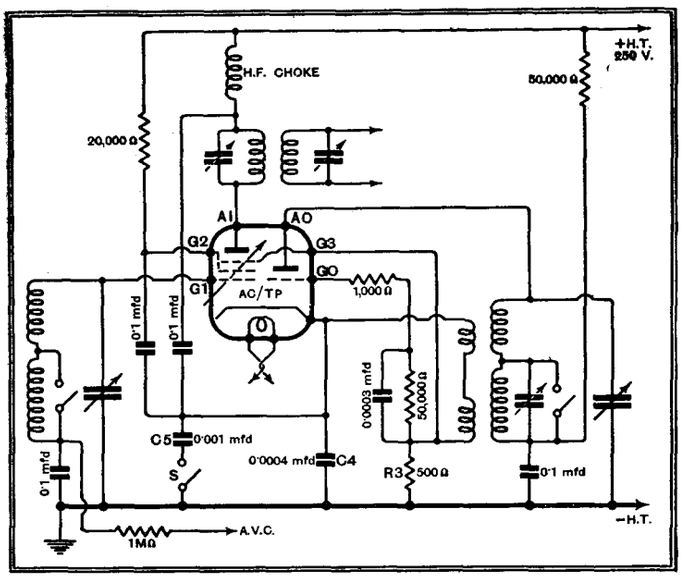


Fig. 3.—Details of a frequency-changer stage embodying the AC/TP valve. First detector and oscillator harmonics have been considerably reduced both in the valve itself and by the special circuit arrangement. The switches should be closed for long-wave reception.

Harmonic Response.

The makers claim that the valve is unusually satisfactory in the matter of harmonic responses, the performance being shown in Fig. 1 and compared with that of other valves. The conversion conductance rises to over 800 micromhos, and the makers' figures for various control grid voltages to the H.F. pentode are shown in Fig. 2. The oscillator section has a mutual conductance of 1.2 mA/volt, permitting loose-coupling of the reaction coil and anode tuning in place of the usual grid tuning. Not only does this minimise oscillator harmonics, but the low capacity between coil windings assists in maintaining more accurate ganging, especially on the long waveband. In designing the oscillator coil assembly,[2] it should be noted that the data is expressed in terms of the ratio of mutual inductance of the two coils (anode and cathode) divided by the inductance of the oscillator tuning coil. This ratio (M/L) should be 12 per cent.

The circuit advocated is given in Fig. 3, from which it will be seen that the oscillator anode coil is tuned and that the cathode coil is wound in two sections. The 1,000-ohms resistance in series with the grid of the oscillator section reduces harmonics, whilst the components R3 and C4 serve a twofold purpose. First they act as a shunt across the cathode coil and tend to produce a load which increases with frequency; secondly, a potentiometer effect is obtained, the voltage across C4 being applied to the pentode control grid. In this way the heterodyne voltage, which normally increases with frequency, is held constant over both wavebands and oscillator harmonics are reduced. Using an oscillator coil as already described and values for R3, C4 and C5 as shown in the diagram, the makers claim that the peak heterodyne voltage varies only between 4.3 and 4.8 volts across the whole tuning range. Grid current overloading is avoided and constant efficiency is obtained.

By feeding the screen of the pentode through a series resistance and not a potential divider, a longer grid base is assured and importance is attached to the decoupling of anode and screen being carried back to cathode and *not* to earth. If the decoupling is to earth there is oscillator-frequency feedback from the pentode and the magnitude of this will vary with A.V.C. Neither must the suppressor grid be returned to earth for to bias it negatively reduces selectivity as a result of lowering the impedance of the pentode.

The AC/TP valve is an important contribution to superheterodyne technique and is likely to become a popular frequency-changer.

[2] [A coil assembly to this design can be obtained from Messrs. Wright and Weaire.—Ed.]

CLUB NEWS

New Society in Hull

A short-wave radio society has been formed in Hull. Full particulars are obtainable from the Hon. Secretary: Mr. R. G. Drewery (G6OY), 274, Park Avenue, Hull.

Mercury Vapour Relay

The Osram gas-filled relay was described and demonstrated by Mr. F. Inchley, of the General Electric Co., at the last meeting of the Smethwick Wireless Society. Hon. Secretary: Mr. E. Fisher, 33, Freeth Street, Oldbury, nr. Birmingham.

Problems Solved

"Questions and Answers" night was recently held by Slade Radio (Birmingham). Members laid their difficulties before the meeting and, without exception, satisfactory solutions were arrived at. Hon. Secretary: 110, Hillaries Road, Gravelly Hill, Birmingham.

Wired Wireless

Re-diffusion systems were discussed by Mr. H. R. Rivers-Moore, President of the Croydon Radio Society, at a recent meeting. Interest was mainly aroused in the subject of wired wireless or "high-frequency re-diffusion" in which the carrier wave of a programme is radiated at radio frequency over wires, being rectified and amplified at the receiver as in the case of a wireless transmission. Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

An Original Formula

A formula for phase correction on the lower frequencies was worked out by Mr. T. H. Bridgewater in lecturing on "L.F. Amplification" at a recent meeting of the London and Home Counties Section of the Institute of Wireless Technology. The formula was original work and aroused considerable interest. The next meeting of the Section will be held on Wednesday, March 28th, when a lecture will be given by Dr. Fawcett on "Wireless as an Aid to Navigation." Full particulars are obtainable from the Assistant Hon. Secretary, Mr. B. Hogben, 272, High Rd., London, N.15.

A Night of Comparisons

L.F. amplifiers are to be compared at a demonstration before the Edinburgh and District Radio Society on March 29th. Full particulars are obtainable from the Hon. Secretary, Mr. W. Winkler, 13, Lockharton Crescent, Edinburgh.

Experimental Station for Amateurs

Arrangements for establishing a Portsmouth and Southsea Wireless Research and Experimental Station are being concluded by the Portsmouth and District Wireless and Television Society. The aim is to enable experimenters, handicapped by lack of facilities at home, to pursue their researches with the aid of the large collection of modern apparatus acquired by the Society. Full particulars are obtainable from the Hon. Secretary, Mr. S. Holland, 54, London Road, Portsmouth.

Mains Transformer Design

Members of the Sidcup and District Radio and Television Club recently enjoyed a lecture by Mr. N. Partridge, B.Sc., A.M.I.E.E., on "The Design of Mains Transformers." The Hon Secretary of the Club is Mr. W. F. Smith, 4, Rowley Avenue, Sidcup, Kent.

A New Name

The Leicester Experimental Short Wave Society has now changed its name to the Leicester Amateur Radio Society. Meetings are held at the Turkey Café, Granby Street, Leicester, at 7.45 p.m. Full particulars are obtainable from the Hon. Secretary, Mr. A. Stimpson, 88, Welford Road, Leicester.

PUBLISHER'S ANNOUNCEMENT

Next week's issue of "The Wireless World" will be on sale on Saturday, March 31st, as the usual day of publication falls on Good Friday.

NEWS of the WEEK

Current Events in Brief Review

More Power Increases

IT is officially announced that Beromunster is to increase its aerial power from 60 to 100 kW. Sottens is to follow suit with an increase from 25 to 50 kW.

"Radio Day"

A RADIO fête to be held at Lille, on April 6th next in connection with the Commercial Fair, is to be honoured with the presence of the French Postmaster-General, M. Mallarmé. The radio festivities will be preceded by a public reception at the railway station, followed by a gathering of the distinguished company at Radio House.

Why not "radio days" in England?

Car Radio : Government Attitude

MR. O. STANLEY, the Minister of Transport, replying to a question in the House of Commons last week, stated that if wireless sets on motor vehicles proved to be a source of danger or annoyance to the public, he might have to consider the prohibition or restriction of their use. The matter would be considered carefully.

Twenty Years After

THE twentieth anniversary of the first broadcast from Belgium will be celebrated by the Belgian stations on Wednesday next, March 28th. On March 28th, 1914, a small group of persons gathered in the Royal Park of the Palace of Laeken, Brussels, at the invitation of the late King Albert, to witness the first wireless telephonic experiments. Among those present was M. Raymond Braillard, now President of the Technical Committee of the International Broadcasting Union. M. Braillard will take part in the commemorative programme on Wednesday next.

The New Arrival

OUR French contemporary, *Haut Parleur*, states that "an interesting event" is about to take place at the Eiffel Tower—none other than the birth of a new wireless transmitter. But as its power will be no more than 10 kW., to comply with the requests of the International Broadcasting Union, the future transmissions will trouble no one, while giving satisfaction to all.

English Programmes from Egypt

TEST transmissions will begin next month from the new 20-kilowatt broadcasting station at Abu-Zebal, Cairo, to which exclusive reference was made in last week's *Wireless World*. The wavelength will be 483.9 metres, i.e., that of Brussels No. 1. The smaller station at Raz-el-Fin, Alexandria, will employ a wavelength of 267.4 metres. Egypt will be "on the air" daily, and its programmes will include news bulletins in English, French and Arabic.

Struggle for an Orchestra

GENEVA and Lausanne are engaged in a struggle, the prize for which is the famous Franco-German Orchestra. The orchestra, threatened by the economic crisis, has had to derive assistance from the Geneva broadcasting station. But as Lausanne is about to acquire new premises with a vast concert studio, an effort has been made to "acquire" the Franco-German Orchestra. If the committee of arbitration decides in favour of Lausanne it is probable that the orchestra will be partly dissolved, as many of its members would decline to move from Geneva. Efforts to save the situation are being made by the famous Swiss conductor, Ernest Ansermet.

FILM RECORDING. A mobile recording van photographed outside the Prince of Wales Theatre, London, a few days ago, when members of the stage cast heard their voices played back within two minutes of recording. The system employs the "photo-electric" gramophone described in our issue of February 2nd last.

The Radio President

PRESIDENT ROOSEVELT has shattered every previous record for radio appearances by a chief executive, writes our Washington correspondent. Records compiled by the National Broadcasting Company disclose that the President gave twenty-six addresses over its networks for the year ending March 4th. The Columbia networks recorded twenty-five microphone appearances during the same period. President Roosevelt delivered four "fireside chats."

City of Many Stations

SHANGHAI, with thirty-five broadcasting stations, holds ascendancy over any European city. Twenty-nine of these are Chinese, the others being owned by foreign concerns. According to a correspondent, the National Government has initiated a "Lucerne Plan" which has assigned a definite wavelength to each station, thus clearing the air and stimulating the sale of radio sets. There are approximately 40,000 in use in the city, ranging from crystal sets to de luxe models.

Speed in Paint

ALL who take an interest in the evolution of the motor car and the continual increases in its speed capabilities will welcome the opportunity to see an exhibition of oil paintings and water colour drawings by F. Gordon-Crosby, of our sister journal, *The Autocar*, at the Ackermann Galleries, 157, New Bond Street, London, W.1. The exhibition is open on week-days, until April 14th, from 10 a.m. to 6 p.m. On Sundays the closing time is 1 p.m. Admission is free.

R.E.S.

THE Research and Experimental Section is the title of a new experimenters' branch just formed by the Radio Society of Great Britain. It replaces the old Contact Bureau, which has done so well for many years as the Society's research organisation. The new body is still under the direction of Mr. H. C. Page, G6PA, who was manager of the Contact Bureau.

Town Honours Radio Station

NEW radio stations usually take their name from the nearest town or village. The custom has been reversed in the case of the well-known Swiss broadcasting station of Beromunster, which stands near the small township of Munster. When the station was opened it was decided to give it the historic name of a local convent, Beromunster, there being no fewer than three Munsters in Switzerland and many more in Germany. Now the Canton of Lucerne has given permission to the Munster authorities to call their town Beromunster.

WAISTBELT WIRELESS. A Los Angeles policeman equipped with a new belt radio set of a type developed by local amateurs. The outfit will probably be adopted for regular use.

Radio Typewriters

TELE - TYPEWRITERS operated by wireless are being tested this month on the American Federal Airways between Washington and Baltimore. They will be used for weather forecasts. If the system should be permanently adopted, the Government will effect a substantial saving in land wire costs.

A Radio Reunion

A MANCHESTER City School Wireless Telegraphy Reunion is to be held on Wednesday, April 11th next, and all ex-operators and ex-students in the Manchester, Birmingham and Nottingham districts are cordially invited. Full particulars can be obtained from the late Principal, Mr. J. R. Halliwell, 31, Bridge Street, Manchester 3.

"Small Ads." at Easter

THE approach of the Easter holidays necessitates slight alterations in our printing arrangements. Miscellaneous advertisements intended for the issue of April 6th should reach the Publishers, Dorset House, Stamford Street, London, S.E.1, not later than first post on Thursday, March 29th.

Loud Speakers or Machine Guns?

THE above is the title of an interesting editorial in our French contemporary, *Toute la Radio*, which discusses the possibility of calming crowds by batteries of loud speakers in place of batteries of guns. It is stated that bloodshed would have been averted during the recent troubles in Paris if the crowd could have been given warning by a public address system that the troops were about to fire. A mobile loud speaker van could "read the Riot Act" in a manner which would overwhelm interruption.

We seem to have read in another French journal that certain of the local broadcasting programmes, if trained on an approaching army, would lead to a *débacle*. This is the same idea in another guise.

Page 207 follows after the Programme Supplement

BROADCAST BREVITIES

By Our Special Correspondent

Who Will Bell the Cat ?

THE proposed Union of Broadcast Workers, which is now being championed by Mr. Oliver Baldwin, received its first public mention in these columns on December 29th last. Since that date staff discontent has grown, despite retorts that the alleged "Prussianism" at Broadcasting House is a myth, and all that now remains to be settled is the choice of office-bearers in the new Union.

As the mice said in the Aesop fable: "Who will bell the cat?"

An Anomaly

The strangest thing of all is that the B.B.C. should have as its Chairman the founder of the Whitley Councils, which have done so much to give every civil servant a voice to air his grievances, if any, and to suggest equitable salary figures.

No member of the B.B.C. staff has a higher court of appeal than his immediate superior.

The Ribbon Microphone

A YOUNG research worker, Mr. Alexander, has been largely responsible for the development of the B.B.C.'s ribbon microphone, which is steadily coming into favour at Portland Place. This microphone, which works on the moving coil principle, may eventually become the standard type for B.B.C. use.

Microphone Research

The B.B.C. now possesses a Microphone and Studio Technical Committee, which concentrates on supplying the best possible quality to the transmitters. It is composed of members of the Balance and Control section, the studio executive and the engineering branch.

The "Mike" for Outside Broadcasts

This Committee has recently been discussing a possible successor to the Reiss microphone which has so many years of honourable service to its credit. It is now felt that the Western Electric type may supersede it for all-round use, being exceptionally robust and, above all, able to stand the hard knocks of "O.B." work. I hear that many new Western Electric "mikes" are being distributed to the provincial stations.

Wanted : the Perfect Microphone

The E.M.I. moving-coil microphone and the Round condenser type are both favourites at Broadcasting House, but it seems doubtful whether any one type will ever sweep the board. There is something to be said for all of them, but no one type of microphone is yet perfect.

Thank You, B.B.C.

"WOZZECK" has come and gone. Most of the music critics averred that the work required several hearings in the concert hall to be properly appreciated, yet the British public was paid the honour of being expected to understand it on a first hearing over the ether.

Thank you, B.B.C.

LISTENERS AT THE MICROPHONE. A month ago a correspondent suggested to us that the B.B.C. might give ordinary listeners an opportunity to broadcast one-minute chats at the microphone. The photograph shows how the idea was carried out recently at Vienna during a radio show.

Stars in Two Firmaments

A "CAVALCADE of Variety" is promised us on April 14th when the B.B.C. will bring back some of the older artistes to tell listeners how microphone work has helped them to success in the music-halls.

This cavalcade will include Norman Long, John Henry, Tommy Handley, Clapham and Dwyer, Mabel Constanduros, and Flotsam and Jetsam.

Tauber in the Studio

RICHARD TAUBER will take part in the studio performance of "Frederica," by Lehar, on April 23rd (National) and 24th (Regional). The eminent tenor will sing in German, but will use English for the dialogue.

A Programme from the Street

"THE Pace Egg, or St. George's Annual Play," was performed until recent years on Good Friday at Midgley, near Halifax, and revived in 1932 as a direct result of a studio broadcast in Leeds. On March 30th it will be performed and relayed to National listeners from the main street of Midgley, where the village folk are assembled for the festivities. The play will be introduced by F. H. Marsden and Mr. H. W. Harwood.

"England"

SIR AUSTEN CHAMBERLAIN will propose the toast of "England" at the annual banquet of the Royal Society of St. George, which is to be relayed from the Connaught Rooms to National listeners on April 23rd. Another topical programme will be the performance on April 24th of Clemence Dane's great classic, "Will Shakespeare," in honour of the dramatist's birthday. Val Gielgud, B.B.C. Drama Director, will produce the play.

Arabian Music

"SWEET is the music of Arabia," says the poet. But is it? Listeners may find out for themselves by listening to Philip Thornton who, starting on May 5th, will play for them on each successive Saturday "music gathered from as many strange countries as train, boat, bicycle, aeroplane or flat feet will permit." They will hear the music of other peoples, who have discovered great beauty in sounds quite unlike those to which we are accustomed in Europe. Music can often speak more effectively than words.

Perhaps listeners will decide at the end of the series that differences are between individuals rather than between nations, even though they be separated by the width of the world.

Tea Mixture

A TOUCHING proof that the B.B.C. reads the newspapers, or, at least, permits its producers to do so, was furnished in the "Tea Mixture" on Saturday, March 10th, when Charles Brewer came to the microphone with these words:

"Have you read the awful news, and what the papers say,
How everyone's gone Prussian at the B.B.C. to-day?
The announcers do not shake your hand, they click their heels and bow.
They have to do the goose-step with the fat stock prices now.
They are holding secret meetings to decide on zero hour,
When the Staff will rise and massacre the chaps who're now in power.
Charlie Hayes and Tommy Handley carry guns slung from the hip,
They're fed up to the teeth, they've fairly got the Greenwich pip."

No censorship here!

Keeping it Dark

THE "Old Lady" type of correspondent rarely troubles the B.B.C. nowadays, and ridiculous questions, such as "What is the wavelength from London to Aberdeen?" do not pour in as they did ten years ago. However, the B.B.C.'s engineering branch smiled the other day when a correspondent added this postscript: "I enclose a 1½d. stamp for your *private* reply, and *not* to tell me over the air."

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page

Delayed A.V.C.

AS most readers are aware, the expression "delayed," as applied to an A.V.C. system, implies that the automatic control does not come into operation until the strength of incoming signals has reached a certain predetermined value. With most systems it is easy enough to adjust this value by trial and error. In describing the operation of his superheterodyne receiver, in which delayed A.V.C. is included, a reader tells us that the strength of what he describes as "quite a weak signal" is increased by temporarily putting the A.V.C. system out of action.

This would indicate fairly definitely that the automatic control comes into operation too early, and so the delay voltage should be increased. It is just possible, however, that due to leakage or some other cause, the standing bias on the controlled valves is increased unduly, and that this source of excess negative bias is disconnected by throwing the A.V.C. system out of action.

Three-band Switching

THE prospective constructor of a receiver designed for all wavelengths between 200 and 2,000 metres (i.e., without the usual break between 550 and 1,000 metres) submits for criticism a circuit diagram showing his proposed system of waveband switching.

It is intended to use two separate on-off switches, one across the long-wave tuning coil, and the second across the series-connected medium- and long-wave coils.

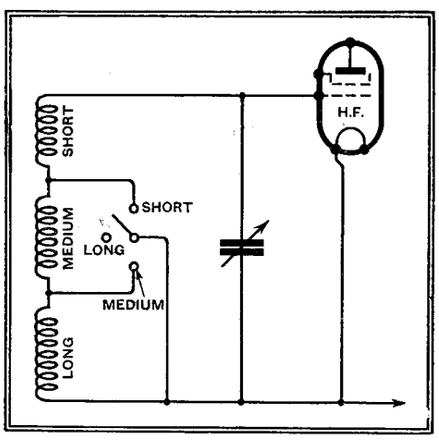


Fig. 1.—Switching system for a triple coil assembly.

The proposed scheme would work satisfactorily, but we think that our correspondent could improve upon it from the point of view of simplicity in construction and particularly in operation. It would surely be better, instead of using two separate switches, to substitute one single-pole two-way switch with a neutral or "off" position. This switch would be wired in the manner shown in Fig. 1, which also indicates the switch positions for each of the three wavebands.

Break-through

THE user of a New Monodial receiver has noticed that a "break-through" of radio signals sometimes occurs when the set is being used for gramophone reproduction. As the H.F. and I.F. sections of the set would appear to be isolated from the L.F. portion under these conditions, we are asked to say whether this would indicate any defect.

Interference of this nature can hardly be due to anything else than the transference of energy through the stray capacities of the wiring, switch and valve. The effect is not altogether abnormal, but the interference may be entirely avoided by opening the switch S1 and setting the resistance R9 to a high value while the set is being used for gramophone reproduction.

Edison Accumulators

A READER who has some Edison accumulators rated at 1.2 volts per cell enquires whether, in view of the fact that it is impossible to obtain a standard L.T. voltage, it would be advisable to operate the filaments of his valves in series.

Academically speaking, there is no serious objection to this course, and we are inclined to think that the series connection of filaments should be avoided in cases where it confers no obvious benefit. In the present case it would seem better to adopt the ordinary parallel connection and to feed the L.T. circuit from two of the Edison cells in series. The surplus voltage, amounting to 0.4 volt, will be absorbed by a suitable resistance.

Maximum Sensitivity

A CORRESPONDENT has found that the sensitivity of his receiver is noticeably increased by using rather less grid bias on the H.F. valve than that recommended by the manufacturer. As a result of this discovery he has made somewhat elaborate provision for critical adjustment of bias by fitting a dry battery and a potentiometer. We are now asked to suggest some neater and more compact system of regulation.

It is a fact that the characteristics of individual specimens of the same type of valve vary considerably—this is particularly true of screen grid H.F. valves. Accordingly, it follows that although the value of bias recommended for a particular valve may be the best so far as average specimens are concerned, it is often possible to improve matters by using a slightly different value.

Our querist has, we think, overlooked the fact that variable grid bias in a mains-operated receiver may be provided in an extremely simple manner. Instead of using the customary fixed cathode resistor for bias purposes, all one has to do is to replace it by a variable resistance having a suitable range of adjustment. If, for example, the resistor normally used has a value of 200 ohms, one might use a rheostat of 400 ohms, which happens to be a standard value. Connections are shown in Fig. 2.

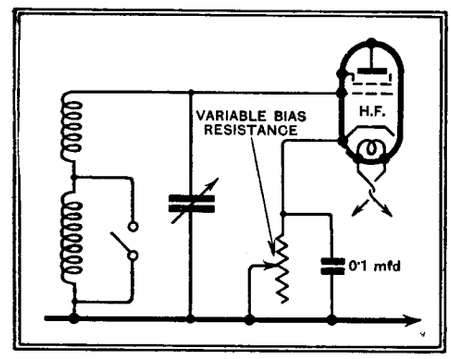


Fig. 2.—Variable bias for an indirectly-heated H.F. valve.

In making the initial adjustment of the rheostat, it may be borne in mind that, so long as grid current is not allowed to flow, sensitivity should increase as the value of the resistance is lowered. It is easy, without any instruments, to detect the point at which grid current begins to flow; as the bias resistance is progressively reduced in value, a point will be reached where tuning begins to become broader, and sensitivity falls off.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

BOOKS RECEIVED

Valve Oscillators of Stable Frequency, a critical survey of present knowledge, by F. M. Colebrook, B.Sc., D.I.C., A.C.G.I. (Special Report No. 13 of the Radio Research Board.)—The accuracy with which wireless transmitters can be adjusted and kept exactly on their allotted wavelength has become a vital matter and the subject of much recent research by a special committee of the Radio Research Board whose progress up to the present time is outlined in this booklet.

Broadcasting and other large fixed stations can maintain a high degree of frequency-stability by means of quartz crystal or tuning-fork control, or by small-power master-oscillators, but these methods while eminently suitable for stations with fixed wavelengths involve somewhat elaborate equipment, and are therefore unsuitable for ships and aircraft where several different wavelengths are employed, and where only much simpler apparatus can be used. The problem of providing frequency-stability without elaborate equipment is at present being investigated.

The report now published is divided into two sections. The first deals with the subject as a whole, and constitutes a practical text-book of the fundamental principles, illustrated by reference to typical circuit arrangements used in practice. The second part consists of abstracts from the most important published papers on the subject.

Pp. 56 with seven diagrams. Published by H.M. Stationery Office. Price 1s.

New Apparatus Reviewed

Latest Products of the Manufacturers

HIVAC DB.240 CLASS "B" VALVE

ALTHOUGH the idea of embodying in one bulb the elements of two or more valves has already led to the development of several interesting types of multiple valves, many more will undoubtedly make their appearance in due course. Evidence that this practice is receiving the attention of valve designers is shown by the introduction by The High Vacuum Valve Co., Ltd., 113-117, Farringdon Road, London, E.C.1, of a combined driver and Class "B" valve.

Designated the DB.240, it consists of three separate triode assemblies mounted side by side, one set forming the driver valve and the other pair the output valves. These are rated to give 1,250 milliwatts A.C. power output when working into a load of 14,500 ohms.

The driver triode has a nominal A.C. resistance of 8,000 ohms with an amplification factor of 10 and a mutual conductance of 1.25 mA. per volt. The new valve is, in effect, a combination of the Hivac L.210 and the B.220, the characteristics of the individual elements being similar to those of these valves. It operates from a two-volt battery and takes 0.4 amp.

An anode potential of 150 volts is required to give the maximum power output, under which conditions the driver portion requires a grid bias of −4.5 volts. It is coupled

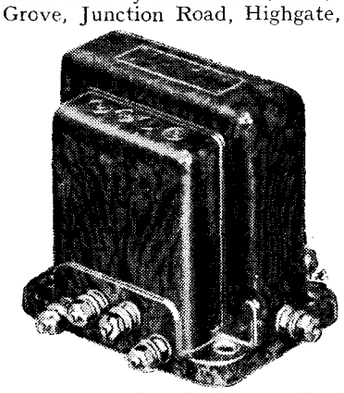
Hivac DB.240 valve combining the functions of driver and Class "B" output valve.

to the Class "B" triode by a 1.5 to 1 step-down transformer, and the total H.T. current taken by the valve is 4.4 mA. in the quiescent state. On test the valve was found to function in a perfectly normal way, and behaved exactly the same as an ordinary Class "B" stage with separate driver and output valves. During these tests no trouble was encountered from parasitic oscillations, but as a precautionary measure it is advised that condensers of between 0.001 and 0.002 mfds. be joined between each output anode and the H.T. positive connection, while a 5,000 to 10,000 ohms resistance, in series with a 0.005 to 0.01 mfd. condenser, be shunted across the output choke or transformer primary, the function of this being to prevent the anode-to-anode load of the Class "B" valves increasing with the frequency. If the resistance is made variable it will serve as a tone control and so provide a means of adjusting the balance between bass and treble.

The price of this new valve is 15s. 6d.

SOUND SALES DRIVER TRANSFORMER TYPE UB

THE type UB Class "B" driver transformer made by Sound Sales, Ltd., Tremlett Grove, Junction Road, Highgate, Lon-



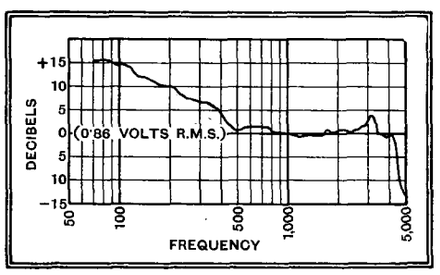
Sound Sales universal Class "B" driver transformer type UB.

don, N.19, is a universal model providing the choice of three ratios, viz., 1 to 1, 1.5 to 1 and 2 to 1. These ratios, which suffice for most present-day needs, are obtained by tapping the primary winding, and one advantage of this scheme is that the relation between primary inductance and the A.C. resistance of the driver valve remains sensibly the same under all conditions of use. The highest ratio gives the largest inductance, and this was found to be approximately 30 henrys with 1.5 mA. of D.C. flowing. With a 1.5 to 1 ratio the primary inductance is 19 henrys, and with a 1 to 1 ratio 10 henrys under the above working conditions.

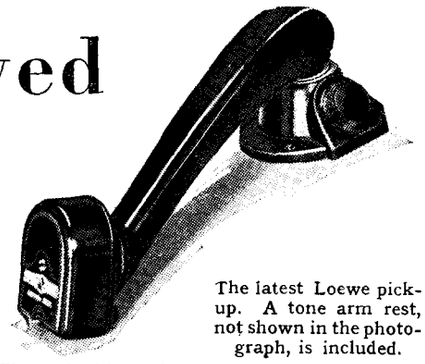
The secondary resistance is quite low, being but 103 ohms total. The transformer proved perfectly satisfactory when tested in a Class "B" circuit; the output judged aurally being clear-cut and well balanced. It is enclosed in a bakelite case, and the price is 10s.

LOEWE PICK-UP

THIS very reasonably priced component is in every way a high-grade instrument. The finish is good, and there is no lack of evidence that the designer understands his job.



Frequency characteristic of the Loewe pick-up with Columbia "Talkie" needle.



The latest Loewe pick-up. A tone arm rest, not shown in the photograph, is included.

The swivel head has an unusually large bearing surface, and a spring tensioning washer ensures complete absence of chattering. A duralumin set screw is used to clamp the needle and the armature, which is of the half-rocker type, is mounted between laminated pole pieces.

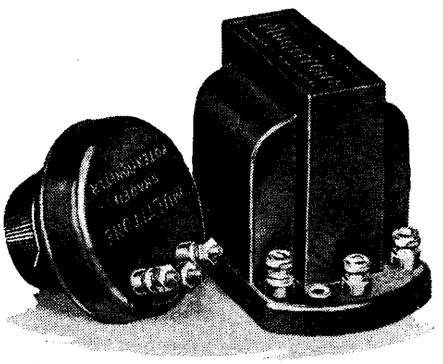
A volume control is incorporated in the base and a rubber-padded rest is provided for the pick-up head when not in use.

The output is ample for all modern receiving sets, and a good response is obtained up to 4,500 cycles. The needle followed the standard frequency test records down to 70 cycles without any trace of chattering.

The price is 18s. 6d. complete, and the makers are The Loewe Radio Co., Ltd., Fountayne Road, Tottenham, London, N.15.

MULTITONE MICROPHONE TRANSFORMER

A MICROPHONE transformer in which provision is made for tone control is now obtainable from the Multitone Electric Co., Ltd., 95-98, White Lion Street, Islington, London, N.1. This model has similar



Multitone tone control microphone transformer and special 4-megohm graded potentiometer.

characteristics to the L.F. tone control transformers made by this firm, and the component should prove very useful in public address equipment required to work under widely different conditions. For the bass can be emphasised, which on occasions may be desirable for dance band repeaters, or a rising characteristic imparted to the output for good intelligibility of speech.

With the specimen tested these several effects were obtained by the adjustment of a 4-megohm graded potentiometer joined across the appropriate terminals of the transformer, the advantage of this scheme being that no alteration whatsoever is needed to the amplifier. It will correct also for the acoustic properties of the hall, or wherever the apparatus is installed. This model has a step-up ratio of 1 to 45; a primary inductance of 1.5 henrys, and a primary D.C. resistance of 12 ohms. The price is 25s. A 1 to 75 ratio type is also available, and smaller ratios can be supplied to order.

Letters to the Editor :—

Wavelength Allocation

Importance of Long Waves : Alternatives to the Disc Record : Television

The Editor does not hold himself responsible for the opinions of his correspondents

Wavelength Allocation

HAVING read the article "Has Broadcast Transmission Reached Finality?" I make no apology for referring to that part of it dealing with allocation of wavelengths under the Lucerne and any other conferences which may provide an excuse for a fraternal gathering of international broadcasting authorities.

Despite the "Weekly Notes" by D. Exer., it is very apparent to listeners that the policy which I have advocated several times in your columns is still the best solution. I refer to the allocation of the frequency band en bloc to individual nations. There might, of course, be a little squabbling—is there ever a conference without any?—among the nations as to the bands which each individual nation would accept, yet those nations with the smallest territory could without loss of "coverage efficiency" take the higher frequencies.

The sensitivity of modern radio sets is unquestionably sufficient to make up for any little deficiency of the foregoing. The day has gone—at least for the majority—when broadcasting authorities must needs think in terms of crystal sets, even of single valve sets. The efficiency of a modern receiver nowadays is such that a three-valve set gives a performance equivalent to a five or six-valve set when the original researches into the efficient service areas of stations now in operation were first conducted. Consequently, we should all gain by this allocation of wave frequencies. We in Britain, also in Germany where single frequency working and technical efficiency have achieved such a large measure of success, could quite easily sacrifice—if it were necessary—a band or two. Britain is better off still, as its new high power long wave station at Daventry will probably give a very efficient service over the whole of England, Scotland, Ireland and Wales.

If this scheme were tried each nation would police its own particular little band, and would, of course, see that its stations worked efficiently. Further, it offers probably the only means of having broadcast reception worthy of the quality of transmission, as it would be possible to arrange for reception up to the full 9 kc/s, or even more. That in itself makes the matter both appealing and urgent.

Your columns usually indicate the trend of research, design, and the employment of modern methods, and it is obvious that technical efficiency is at present possible in a far higher measure than we can use, by virtue of the ridiculous restrictions imposed by a narrow outlook on this matter.

If the seed is sown far and wide—and *The Wireless World* is by far the best place to sow it—we may perhaps achieve broadcast reception worthy of the name.

9 kc/s, Not 4.5 kc/s.

Correspondence, which should be as brief as possible, should be addressed to the Editor, "The Wireless World" Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Importance of Long Waves

YOUR correspondent, Mr. M. R. Brooks, whose letter in your issue of March 9th advocates the abandonment of the long wave transmitters, obviously has no knowledge of conditions in parts of the country other than that in which he lives.

Before he puts forward such a suggestion he should remember that there are many districts far removed from any medium wave transmitters where the only reliable signals are received from the long wave stations. As an example, in this district we have no local station whatever, and although I am using a highly selective Superheterodyne with automatic volume control (*Wireless World* New Monodial), all medium wave transmitters are entirely unreliable after sundown.

Even the West Regional, situated 37 miles from us in a direct line, has serious fits of fading and distortion, and the West National is little more than a joke. Possibly, too, Mr. Brooks does not know that spark transmitters as a source of interference on the medium wave band are still by no means extinct, and are very active during the hours of daylight, thus causing very serious interference with signals which, during such hours, are otherwise passably good.

If, therefore, we want to listen to any British Broadcast with a minimum of interference, we are compelled to rely upon the Daventry long wave transmitter, and as there are at present no further proposals for other stations that may be helpful in such districts as ours, we are looking forward with keen anticipation to the inauguration of the new and more powerful long-wave transmitter at Droitwich.

I do not for a moment suppose that Mr. Brooks' letter will have the slightest influence with those responsible for broadcasting in this country, but I should like to register a protest at the course he has suggested, obviously with so little thought of others and without any true knowledge of the facts.

Torquay. GRAHAM HUNT.

Alternatives to the Disc Record

I SHOULD like to thank all those of your readers who have written on the subject of alternatives to the disc record since the publication of my first letter last October. It is gratifying to learn that others agree that the present system is far from perfect, but I think many of the correspondents missed the point of my letter, which was not so much that a long-playing reproducing system was not at present on the market as that the monopoly gramophone companies were not only making no efforts to develop one, but were doing everything they could to stop anyone else from doing so. Since last October, I have heard of several inventions which have been bought up. I have been told that the Selenophone has suffered this fate.

Only one letter has appeared from the "official side," and that was from the Gramophone Company, stating a *non possumus* and rather smugly hinting that they have always given us the best music regardless of their pockets. It was a long time before they could be induced to publish uncut recordings of symphonies or any recordings of string quartets. At last they have learnt that there is a public for great music, but they are still half-hearted; otherwise it would not have been necessary to form a Sibelius or a Beethoven Society. After all these years, they have only just begun to issue complete recordings of Bach's forty-eight preludes and fugues.

Even if I had a double turntable instrument I should not be much better off. I contend that one's whole enjoyment of gramophone music is ruined by having to change records every seven minutes or less. Surely the problem can be solved, and the big companies with all their money and brains are the ones to solve it. Sound film may well be too expensive and too perishable, but is there no other way? Hill and dale recording seems to be a step in the right direction if it will enable complete movements of most works to be played without a break; what musicians want, however, is to be able to put on a complete work and then sit back and enjoy it. The present apparatus is adequate for dance music, and I hope the companies will continue to prosper in this sphere. But could they not spend some of their profits on the development of something better for the serious musician? The money might turn out to have been well spent after all; there is room for the Rolls Royce as well as the Ford in this world.

PATRICK KING,
Flight Lieut., Royal Air Force.

Television

I AM writing to say how completely I agree with your editorial comment in the issue of *The Wireless World* for March 2nd, and with the opinions expressed elsewhere in that issue on this subject.

I have a home constructed mirror drum-crater neon outfit with which I obtain pictures 15in. high, and having now got over all synchronising troubles, the results obtained are very good indeed and compare very favourably with a home cinematograph. Every person to whom I have given demonstrations expresses great surprise that such good results can now be obtained, but they would not dream of purchasing complete apparatus for themselves because they think it will soon be obsolete. I agree that it is high time that the B.B.C. made a definite statement on the subject, particularly in view of the fact that high definition televisions cannot be broadcast as yet, except on ultra short waves, which would require multiple transmitters.

It would be absolute madness to curtail the present transmissions, as obviously the

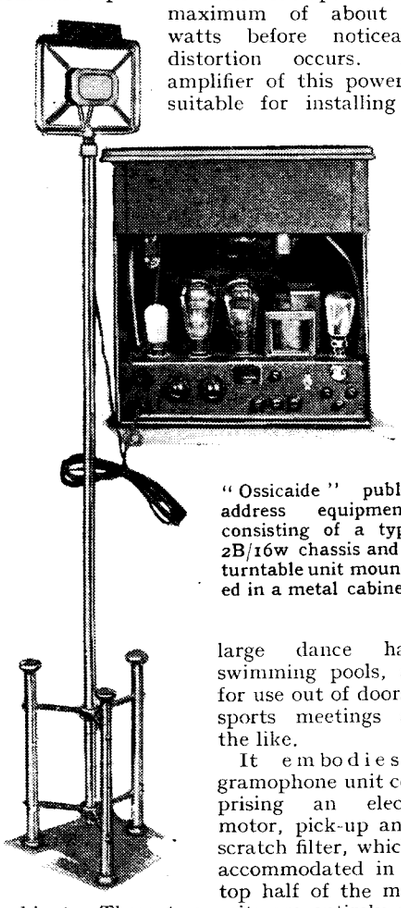
public are waiting for more frequent and longer transmissions at a more convenient hour, and the manufacturers are waiting for the demand. I am sure that the results that can be obtained by 30 line televisions are quite good enough for the average man in the street, and the transmissions are continually improving. I very much hope that the B.B.C. will decide to continue these 30 line transmissions for a long time yet, in fact, until the high definition system is quite ready. Even then I consider there will be a demand for 30 line transmissions by those who cannot afford the more expensive apparatus.

Croydon. ROGER F. C. CROWLEY.

"Ossicaide" Public Address Equipment

An A.C.-operated 55-watt Amplifier and Electric Gramophone in Transportable Form

THE "Ossicaide" public-address equipment illustrated is fitted with a type 2B/16w chassis, rated at 55 watts anode dissipation, and giving a nominal output of 16 watts with a permissible maximum of about 20 watts before noticeable distortion occurs. An amplifier of this power is suitable for installing in large dance halls, swimming pools, and for use out of doors at sports meetings and the like.



"Ossicaide" public address equipment, consisting of a type 2B/16w chassis and a turntable unit mounted in a metal cabinet.

It embodies a gramophone unit comprising an electric motor, pick-up and a scratch filter, which is accommodated in the top half of the metal cabinet. These two units are entirely self-contained and are interconnected by two twin-cables: one plugs into a gramophone socket, and the other, also terminating in a plug, carries the mains supply to the electric motor.

All the controls, with the exception of the scratch filter, are arranged on the front of the amplifier chassis and they comprise a volume control, tone control, and mains switch; in addition, there are three output terminals, for matching loud speakers of 7.5 ohms and 15 ohms respectively, mains and H.T. fuses in screw-in holders and two input jacks. One is for the gramophone, and the other for a microphone.

Control of volume is effected by means of a centre-tapped potentiometer which answers for both gramophone and microphone; clockwise rotation gives an increase for the former and anti-clockwise movement brings in the microphone. It acts, therefore, as a fader from one to the other.

The 2B/16w chassis is an A.C.-operated two-stage amplifier, the circuit consisting of an input triode coupled by a resistance-fed tone control transformer to two PM24D power pentodes connected in parallel. Their combined output is fed to a step-down transformer by a choke-capacity filter. Anode and grid circuits are fully decoupled, and every precaution is taken to suppress parasitic oscillation in the output stage. It is a perfectly straightforward design based on well-tried practice and applied in a sound manner, the workmanship throughout being very good indeed. High-grade components are employed, which, having an adequate margin of safety, minimise the risk of breakdown, so that the amplifier should prove quite trouble-free in operation.

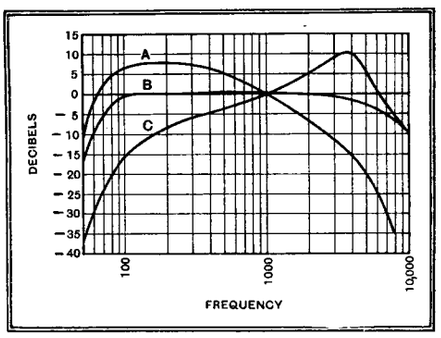
As the amplifier embodies a Multitone L.F. transformer its characteristic can be modified to give the most satisfactory performance according to the type of matter relayed. An accentuation of the bass will be needed, as a rule, for gramophone reproduction; music and speech would probably come through best without artificial aid, though the acoustic properties of the hall might necessitate some form of correction. Then again, some speakers have good microphone voices, while others are either high or low pitched, and a little correction makes for better intelligibility. Thus the ability to modify the characteristic of the amplifier is a real advantage, and the curves here reproduced show some of the forms this may take. In Curve A the tone control is set for maximum bass response, which is accompanied by a marked high-note attenuation. The other extreme setting gives a rising characteristic as shown by curve C, whilst in an intermediate position a sensibly flat response, curve B, results. In addition to this form of tone adjustment there is a scratch filter, also variable, mounted on the motor board, its function being to suppress record surface noises. It answers, also, as a fixed potential divider restricting the output from the pick-up to avoid overloading.

These deductions of the amplifier's performance from an examination of its characteristic curves were fully confirmed by a practical test. Gramophone reproduction can be made exceedingly good by suitable adjustment of the tone control.

Using the microphone supplied, best intelligibility of speech was obtained with the tone control set to give a slight bass accentuation, as the microphone seems to have a particularly good high-note response. This is a sensitive transverse current carbon instrument mounted on an adjustable stand and finished in chromium. The adjustment allows for the microphone to be set at any height between five and six feet. Described as the "Foot" microphone, it costs £7 10s. in this form, but a table model is available at £4 10s.

On the whole, the equipment is well suited to the special requirements of public address work. It is robust, self-contained, and transportable, and, of course, as in apparatus of this size, is A.C. operated. The mains transformer is tapped for supplies of from 200 to 250 volts, variable in steps of 10 volts, and the price complete as illustrated is £44 10s. The type 2B/16w amplifier chassis alone costs £36. A turntable unit, fitted with an automatic record changer, is available at £14 14s.

The makers are "Ossicaide," 447, Oxford Street, London, W.1.



Characteristic curves of the "Ossicaide" 2B/16w amplifier with various setting of the tone control. Curve A shows full bass response, B relates to an intermediate position, and curve C to maximum treble response.

The Radio Industry

A NEW move in the war on interference is announced by the Marconiphone Company. All the usual causes of interference have been systematically investigated, and the distinctive sounds due to various interfering apparatus have been recorded on a series of gramophone discs. By using these records it is possible to establish definitely the cause of the trouble—a great help towards its ultimate elimination.

Partridge and Mee, Ltd., 74, New Oxford Street, London, W.C.1, are shortly marketing a home recorder of high-grade design. Metal discs of special alloy will be used in conjunction with a steel cutting needle, and an immediate play-back will be possible without processing the record. We have seen a demonstration of one of the advance models, and the quality is of an extraordinarily high standard. Re-recordings of commercial records are indistinguishable from the original. The price of the new recorder, we understand, will be £25.

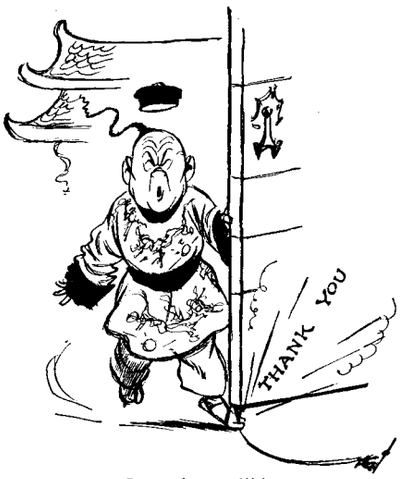
A leaflet giving technical data on the use of the new low-capacity Westector, Type WX, is available from the Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York Road, King's Cross, London, N.1.

The uses of the Wearite Second Channel Whistle Suppressor, which was recently reviewed favourably in this journal, are described in a leaflet recently issued by Wright & Weaire, Ltd., of 740, High Road, Tottenham, London, N.17.

Mr. F. J. Philips, son of the founder of Philips Lamps, Ltd., recently addressed an audience in Sydney at the opening of the Australian Radio and Electrical Exhibition. Mr. Philips spoke from the London office of his firm via the Post Office short-wave telephony channel.

UNBIASED

By FREE GRID



Scarcely credible.

More Chinese Lore

THE when-was-the-gramophone-first-invented controversy has suddenly taken on a new lease of life and I have received several letters concerning earlier paragraphs on the subject.

One correspondent, well versed in ancient Chinese lore, points out that the particular applications already mentioned by no means exhausted the resourcefulness of this ingenious race. Apparently the ancient celestials were as much troubled as we are by pestilential people who go out of the room without shutting the door, for my correspondent came across a door fitted at its outer bottom corner with a stylus running in a semi-circular track carved in the jade floor in one of the sumptuous palaces of old Cathay.

As the door was opened, the needle running in the track caused the words "Shut the door" to be ejaculated. The strangest part of the whole business, however, was that when the door was closed the backward run of the needle in the same sound track produced the words "Thank you." "This remarkable phenomenon," adds my informant, "which at first seems scarcely credible, was only made possible by the fact that in the Chinese dialect then spoken by the mandarin class, the normal expression of gratitude sounded exactly the same as 'shut the door' said backwards."

As for the sound box and horn, he explains that these two were combined and a large diaphragm was used somewhat similar to that employed in the Lumière type gramophone produced over here in 1924. In actual practice, however, the diaphragm took the place of the bottom panel of the door and consisted of the customary stretched skin, although not a missionary one, as it was found that, owing to constant persecution, the hides of these gentry had become too tough for the purpose.

Yet another correspondent informs me that he is in possession of a repeater watch made for Catherine the Great of Russia in which the hours are given by the spoken word instead of the usual bell arrangement. This is accomplished by a miniature gramophone disc made of metal upon which the words are engraved, use apparently having been made of an electric engraving machine such as is used nowadays for dog collars and such-like things.

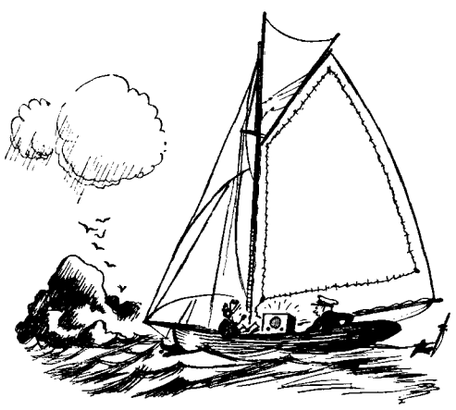
Unhappy Ending

THE truth of the old saying that a little learning is a dangerous thing was never more apparent than in the case of a couple of amateur yachtsmen in the matter of a little radio difficulty about which they consulted me.

The fact that acceptance of my advice nearly resulted in a coroner's inquest is neither here nor there, the point being that this inglorious consummation was prevented, not by anything amiss with the technical advice I gave them, but by their own pig-headed foolishness in trying to graft their own imperfect and superficial knowledge of radio on to mine.

It happened that they had bought, or otherwise acquired, a small sailing yacht with which they proposed to idle away the long summer days with their female friends, and wished to know how to arrange their aerial and down-lead so as not to foul the running gear.

At once I advised them to adopt an aerial arrangement which I had seen used with marked success on a yacht on which I was an honoured guest during Cowes week a year or two back. This was to sew wires into the mainsail near its perimeter so that they formed a frame aerial of prodigious dimensions.



Nasty looking piece of shore.

Now, as every reader of *The Wireless World* knows, the directional effect of a frame of this size is virtually nil owing to the large preponderance of the "vertical" element in it. Unfortunately, however, the two embryo yachtsmen were so blinded by their own knowledge (?) that they were unaware of this, and on their first evening afloat, desiring to get the latest racing results, they shaped their course so as to get the frame aerial in the position which they foolishly supposed to be the *sine quâ non* for receiving London.

With this end in view one of them donned 'phones and was soon engrossed in copying down horse-racing results while the other remained on the look out. They were, as it happened, heading for a particularly nasty looking piece of the shore, but as they were as yet a great way off there seemed ample time available for getting the full results before the necessity arose for altering course.

Whether they had miscalculated their distance or the force of the wind will always remain a mystery, but it soon became apparent to both that it was to be a neck and neck race between safety and getting the result of the last race. A slight hesitation on the part of the London announcer, due to a suppressed sneeze, proved the decisive factor in the race, and they were only rescued with considerable difficulty.

Wagner's Big Hit

IF there is one thing I do detest, it is the misuse of the word "number" to describe a musical work, even if it only be a wretched dance tune. I thought, however, that the height of absurdity was reached the other night when the leader of a dance band which had just finished jazzing some of the classics announced, in the tone of one imparting a piece of profound wisdom to a wondering world, that "the Tannhauser overture was one of Wagner's most popular numbers."

Musicians, both dead and living, have had to put up with many insults at the hands of the B.B.C. during the past ten years. There is no need to add to the collection.

The Boat Race

I OFTEN wonder why the B.B.C. did not use the heaven-sent opportunity of the Boat Race to popularise television.

My suggestion was that they should televise from the studio a large map of the course and arrange for two spots of light representing the boats to chase along it during the progress of the race. This could easily have been done by projecting the spots of light on to the map by means of a couple of focussed flash-lights—or at any rate something not very much more more elaborate—wielded by a couple of people who would be following the running commentary from a loud speaker in the television studio. Any objections, please?

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Wavelength Allocation

A Scheme of Promise

IN last week's issue a reader put forward in the correspondence columns a suggestion regarding wavelength allocation in Europe. This proposal has previously been made through the columns of *The Wireless World* by the same reader and has been the subject of comment.

Put briefly, the idea is that instead of distributing wavelengths amongst the various countries on the present lines, so that French, German, British and Italian stations jostle one another in all too intimate contact, each country should be allotted a definite band, or bands, of wavelengths exclusively for their own use.

The idea offers certain obvious advantages. If stations strayed from their allotted frequencies they would cause heterodyning, not with the station of a neighbouring country, but with another station of their own nationality and, therefore, under the same administrative control. Stations which might be indifferent to causing trouble with reception in another country would be obliged to look at the matter differently when they were found to be encroaching on one of their own transmitters.

If wavelengths were allotted in bands each country would have the option of making use of the band as it pleased—that is to say, it could use the band for the maximum possible number of stations, even at a sacrifice of quality, or it could arrange for very high quality transmissions from a limited number of transmitters, or it could decide to compromise and have one or more very high quality stations for special broadcasts and make the rest restricted in their frequency band.

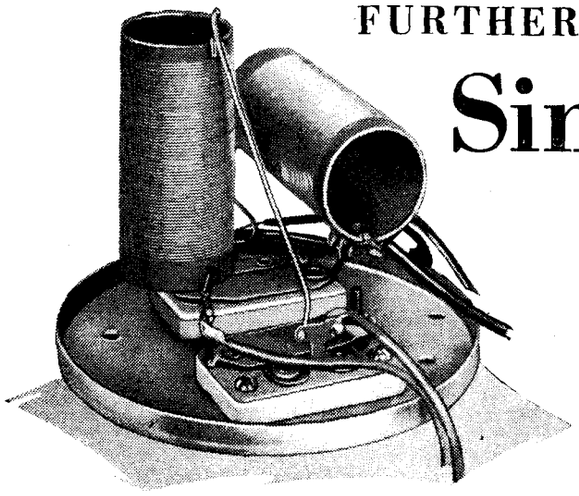
In order to safeguard each individual band from encroachments from the next country, it would be possible to set up "frontiers" if necessary. The "frontiers" would take the form of a very narrow band transmitter between each national allocation, and this "police" transmitter could be started up when required, to ensure that frontiers were not overrun.

There are, of course, objections which can be put up against this idea, but they are no longer so serious as they were when the plan was first put forward some time ago.

Objections Overcome

First, wavelengths are not all of equal efficiency, and there would probably be a scramble for allocations in the higher wavelengths rather than the low. Where necessary this objection might be overcome, either by allotting two smaller bands, one high and one low, or a wider band might be given in certain instances by way of compensation for poorer efficiency. This question, however, is not so serious as it used to be, as increases in power have, to some extent, overcome the limitations of the lower wavelengths.

Another objection which would certainly be raised is that putting all the stations of one country into adjacent wavebands would necessitate the use of selective receivers to separate the programmes. This is, of course, true, but the day of crystal sets and unselective receivers is past, and modern receivers have adequate selectivity for the purpose. The B.B.C. originally planned their distribution policy on the basis of crystal set reception. It would have been a sad business if that policy had not been scrapped in the interests of progress. It would be unreasonable to put up against a scheme which promises so many advantages the objection that its introduction would render obsolete sets which are really already obsolescent.



An early type of I.F. transformer employed in experimental work; the two coils are coupled together by their mutual inductance.

FURTHER DETAILS OF Single-span Tuning

Eliminating Ganging and Waveband Switching

By W. T. COCKING

The new single-span receiving system developed by "The Wireless World" has so many advantages over older methods that it is important to understand the principles involved. The previous article gave an outline of the method, and this week it is gone into in greater detail. Reasons why the system gives improved quality of reproduction as well as a wide tuning range and no ganging are fully explained

PRELIMINARY details of the new receiving system were given in last week's issue of *The Wireless World*, and it will be remembered that it enables single-control tuning over the full range of 200-2,000 metres to be obtained without waveband switching, gang condensers, or matched coils. Furthermore, the absence of ganging leads to the removal of the necessity for any ganging adjustments.

The new system involves two radical changes from ordinary practice—the aerial circuit is made aperiodic over the required range, and the intermediate frequency is made higher than that of any desired signal. Each of these two points is essential to the attainment of the required results, but the latter is the more involved and deserves more lengthy treatment.

If it were not for questions of second channel interference the signal-frequency circuits of any superheterodyne could be made aperiodic, and tuning carried out by means of the oscillator condenser only, for the adjacent channel selectivity, upon which the separation of neighbouring stations depends, is dependent almost entirely upon the I.F. amplifier. Under normal conditions the intermediate frequency is lower than that of any wanted station. Thus, a frequency of 110 kc/s is almost standard and is produced in a superheterodyne by combining a locally generated current of frequency 110 kc/s different from that of the desired signal and applying the result to a rectifier.

In order to receive a station with a frequency of 1,000 kc/s (300 metres), therefore, the oscillator can be set to 1,100 kc/s, or to 890 kc/s. Since there are two settings for every station there are also two stations for every oscillator frequency which can be transferred to the intermediate frequency. Thus, if the oscillator be set at 1,110 kc/s for a station on 1,000 kc/s, a station working on 1,220 kc/s will also produce the intermediate frequency and so cause interference. It is in order to avoid this that signal-frequency tuned circuits are fitted to every superheterodyne.

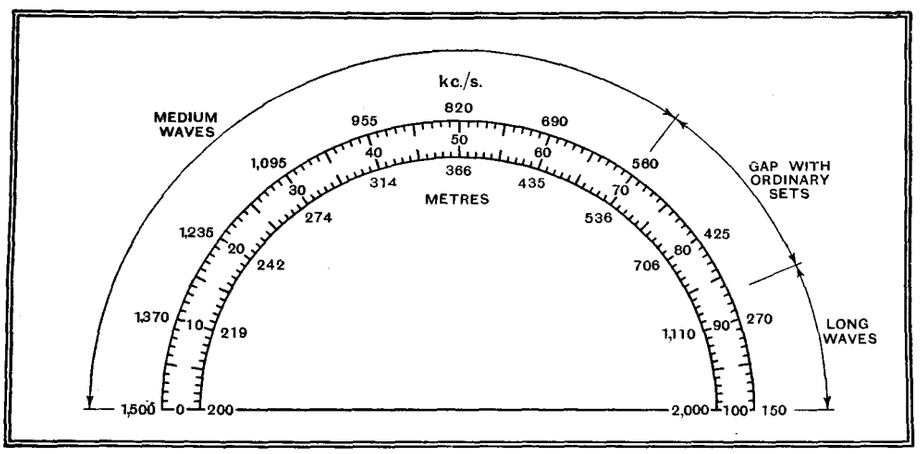
The intermediate frequency cannot well fall within the desired frequency range, but it is by no means essential for it to be lower, and so far as the frequency-changing process is concerned there is no reason why it should not be higher. Suppose a frequency of 1,600 kc/s were used, therefore, since the highest frequency used in normal broadcasting is 1,500 kc/s, and the lowest is 150 kc/s. For the reception of a 1,500 kc/s station the oscillator would be set at either 100 kc/s or 3,100 kc/s, and for a station on 150 kc/s it would work on 1,450 kc/s or 1,750 kc/s. The higher frequency oscillator settings would naturally be used, since some of the lower frequencies fall within the receiving range.

The Oscillator Range

The oscillator, therefore, must tune over the range of 3,100-1,750 kc/s for receiving stations between 1,500 kc/s and 150 kc/s. Reception from stations on frequencies higher than the oscillator by the intermediate frequency will also produce the requisite beat and may cause second channel interference. It is of the first importance to note, however, that stations which can cause second channel interference lie between 4,700 kc/s and 3,350 kc/s—a much higher range than the broadcast band.

Unlike the ordinary superheterodyne, second channel interference is possible only from stations operating on frequencies much higher than the broadcast band. It is thus readily possible to eliminate it completely by using an aerial system which is aperiodic over the 1,500-150 kc/s range, but which greatly attenuates signals of higher frequency. It will be seen, therefore, that it becomes possible to avoid the use of tuned signal-frequency circuits and let the oscillator tuning condenser be the only tuning control in the set. The natural consequence of this is that a gang condenser becomes unnecessary and matched coils are no longer needed, while, since the tuning of one circuit only is varied for the reception of different stations, there are no ganging adjustments.

The second important result of using an intermediate frequency higher than that of any received signal lies in the extension of the tuning range which is possible. The band of frequencies which can be covered by a single coil and variable condenser depends on the ratio of maximum to minimum capacity. The ratio of maximum to minimum frequency, in fact, is equal to the square root of the capacity ratio. It is



With a true S.L.F. tuning condenser the calibration of a single-span receiver would be given by this diagram. The medium waves are spread over 70° and the long waves are covered by the last 13°. Wavelengths between 536 metres and 950 metres which are missed by ordinary sets tune in between 70° and 87°. In spite of the apparent crowding of the long waveband, tuning is no sharper than on low wavelengths, but with a condenser of different law the scale would be less open at low wavelengths and spread out to a greater extent at high. It should be noted that this scale is purely illustrative and does not refer to any particular receiver.

Single-span Tuning—

not usually possible to obtain a capacity ratio of more than about 9-1 and still retain efficiency, so that the frequency range is restricted to 3-1. If the highest frequency required is 1,500 kc/s (200 metres), the lowest within the range of a single coil is 500 kc/s (600 metres). It is a common experience to find difficulty in covering even this range with one coil. In all ordinary sets, therefore, two coils are used to cover the 1,500-150 kc/s band, and even then there is usually a gap between about 540 kc/s and 350 kc/s.

With the new system, however, it is necessary to vary only the tuning of the oscillator circuit, and this functions on a much higher frequency. As a result, although the difference between the maximum and minimum frequencies is the same, the ratio of maximum to minimum frequencies is much smaller. Consequently, a wider received frequency range can be covered with the same condenser or the same range with a smaller condenser. With an intermediate frequency of 1,600 kc/s the band of 1,500-150 kc/s can be covered with an oscillator condenser giving a capacity ratio of only 3.14-1, for the oscillator frequency has to vary in the ratio of 1.77-1 only.

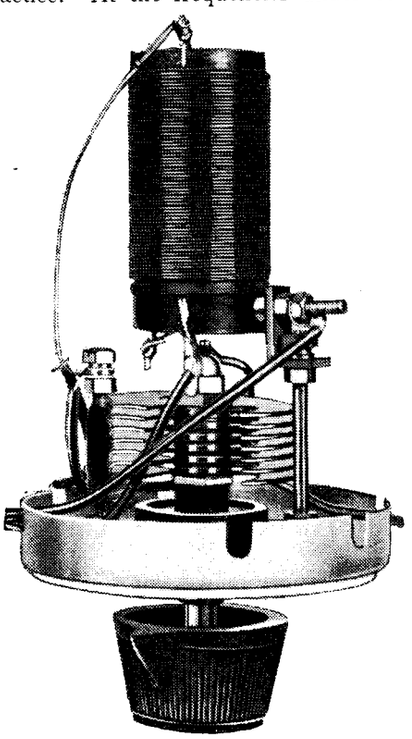
The higher the intermediate frequency the greater the possible receiving range for a given tuning capacity, and by proceeding to extremes it is possible to conceive of a receiver covering from 12 to 2,000 metres in one band. With an intermediate frequency of 30 mc/s (10 metres) the range of 25,000-150 kc/s (12-2,000 metres) could be covered by an oscillator tuning between 55 mc/s and 30.15 mc/s, a frequency ratio of 1.825-1. A capacity change of 3.33-1 would be needed, and would easily be possible. A set of this nature is hardly feasible at present, however, on account of the difficulty of obtaining both amplification and selectivity at frequencies of 30 mc/s, but it well illustrates the wide received frequency range which is possible without coil changing through the use of a high intermediate frequency.

Selectivity and Quality

Since a receiving range of 1,500-150 kc/s is all that is needed for normal purposes, the intermediate frequency need be only slightly higher than 1,500 kc/s, and 1,600 kc/s is probably the most convenient lower limit. The higher the frequency used the easier it is to design an aerial circuit which will eliminate second channel interference; on the other hand, the more difficult will it be to obtain high adjacent channel selectivity. The selectivity, of course, is provided by the I.F. circuits, and depends on the efficiency of the individual circuits, their number, and their operating frequency.

If the circuits used at 1,600 kc/s have the same efficiency as those which would be employed at 110 kc/s, the selectivity will be much lower at the higher frequency unless an increased number of tuned circuits be used. If the number of circuits be the same in the two cases, their efficiency must be higher if adequate selectivity is to be obtained at the higher frequency. This selectivity question, in fact, represents the only difficulty in the way of the new system of reception. In view of its other manifold advantages, therefore, it is fortunate that it is by no means an insuperable one.

The design of an I.F. amplifier largely resolves itself into a question of coil design, and for a given bulk it is possible to make a more efficient coil for operation at a high frequency than at a low. Dielectric losses, however, become much more important at high frequencies, so that the full coil efficiency which is theoretically possible is not obtainable in practice. At the frequencies under consideration the use of iron-cores for coils does not appear to lead to any improvement, probably because the normal losses are chiefly dielectric and the introduction of iron only reduces the copper losses in a coil.



This illustration shows one of the I.F. tuned circuits employed in the development of single-span tuning. An air-core coil is used, and is tuned by an air-dielectric condenser. In practice, both condenser and coil are covered by a screen.

Owing to these various factors, it would not be possible to obtain a degree of selectivity even approaching that of the ordinary superheterodyne, were it not for the aid of reaction. With reaction the losses in at least one circuit can be reduced almost to vanishing point, with the result that the selectivity can be enormously increased. As a consequence it is easy to obtain adequate selectivity for modern broadcasting conditions in spite of the use of a high intermediate frequency.

The use of reaction is beneficial in another way and leads directly to a considerable improvement in the quality of reproduction. This surprising statement may need some explanation. With an ordinary superheterodyne the selectivity is made sufficiently high to permit interference-free reception of distant stations, so that a certain restriction of the upper register is inevitable. Since the selectivity is fixed, this means that the quality of reproduction on local stations and the stronger of Continental transmitters is poorer than it need be, for these stations do not need such high selectivity, and if suitable means were available the high frequency response could be increased without interference being introduced.

Variable Selectivity

Variable selectivity is necessary if the best quality of reproduction is to be obtained under all conditions, but this is usually very difficult to obtain. With the high intermediate frequency of the new system, however, reaction may be used to give a wide range of selectivity. In the absence of reaction, the selectivity is adjusted to be as high as possible without introducing more than a very minor degree of sideband cutting. This leads to a very high standard of quality and moderate selectivity and is suitable for local reception. The use of a small amount of reaction increases the selectivity sufficiently for the reception of the stronger of distant stations, and affects quality only to a small degree. In cases where interference is severe, critical reaction may be used and a high degree of selectivity obtained; the quality will necessarily suffer under this condition, but no more than it would do with any other method of obtaining an equivalent degree of freedom from interference.

The employment of reaction, of course, raises a number of extremely interesting design problems with which it is hoped to deal in a further article. It may be said, however, that the difficulties of applying it to an amplifier of high gain have been overcome, and that in practice it functions as a pure selectivity control and not like the customary regenerator.

So far nothing has been said regarding the efficiency of the new system, Owing to the use of an aperiodic aerial system, it is likely to be somewhat lower than that of an ordinary superheterodyne with the same number of valves.

With a tuned aerial circuit and modern coils and the customary loose aerial coupling the voltage applied to the grid of the first valve may vary between twice and five times that set up in the aerial by the signal. With the aperiodic aerial coupling the gain is less and averages about unity. There is a variation over the waveband and at some frequencies there is a gain of about twice, while at other frequencies there is a loss of the same order.

This is, however, a matter of little consequence as the amplification can be readily increased to compensate for this. Even if in some cases an additional valve were needed, this would not necessarily mean any increase of cost in a comparison with an ordinary superheterodyne, for the saving effected by the elimination of gang condensers and matched coils more

Single-span Tuning—

than offsets the cost of another valve.

Apart from its advantages in simplifying the receiver the absence of signal-frequency tuned circuits is very important in regard to quality of reproduction. The only tuned circuits which control the selectivity, and hence the amount of sideband cutting, are in the I.F. amplifier. Consequently, the selectivity and quality are both exactly the same whatever station is being received. In all ordinary sets the selectivity increases with wavelength, and the quality consequently deteriorates, for no fixed tone-corrector can compensate for a variable degree of sideband cutting. The constant selectivity with wavelength of the new system, therefore, means that quality is also constant. This is most noticeable when receiving long-wave stations, and the improved reproduction from stations such as Radio Paris and Daventry National is very marked.

In next week's issue of *The Wireless World* a further article on the new receiving system will appear and will deal with the I.F. amplifier and the details of the reaction circuit.

DISTANT RECEPTION NOTES

An Answer to Critics : Interference-free Stations

IT seems a pity that the Swiss Federal Assembly could not ratify the proposed agreement with Austria, which was framed with a view to preventing either country from flooding the other with unwelcome propaganda. Politics are the curse of broadcasting to-day. It is mainly owing to them that the European wavebands are overcrowded. They are responsible, too, for not a little of the over-modulation that occurs, this being employed to ensure longer-range reception for the spoken word.

The new scheme for the long waves seems fairly satisfactory, and one hopes that it will be adopted. It is interesting to see that the long waveband has been extended up to 1,948 metres. How Minsk, Warsaw, Motala and Kharkov will share the four wavelengths that are handed to them, with instructions to fight it out between themselves, no one can say yet. Motala, though, will be a force to reckon with when the new 150-kilowatt transmitter comes into operation.

Since I last wrote I have received many more letters from readers on the subject of Heilsberg and its heterodyne. Careful watching of the station shows that though the time at which the heterodyne begins varies somewhat, Heilsberg is nearly always clear early in the evening, and invariably heterodyned by 9 or 10 p.m. at the latest.

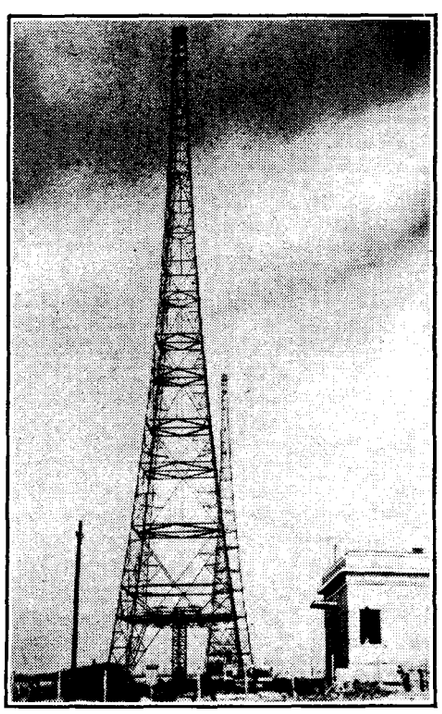
The late hour at which the heterodyne often starts suggests a Spanish or Portuguese station. I believe that the trouble is due sometimes to Parede, but more often to Barcelona EAJ15. This latter station has lately been notorious for its bad wavelength-keeping.

One reader accuses me of drawing the long-bow in stating that numbers of stations are receivable clear of interference. I was never good at archery, metaphorical or otherwise! Nor would there be any point in stating that I could receive stations well if I didn't. Nor again should I bother to listen for an hour on end to Rome, Budapest or Vienna, as I often do, if their transmissions were accompanied by the fine variety of interfering noises my correspondent describes. He must, I think, be suffering severely from local man-made static.

All of my friends have wireless sets; few of them care about making big bags of stations just for the sake of doing so; yet all make great use of foreign stations for entertainment purposes. They possess a large variety of sets, and I never go to the house of one of them without switching on his apparatus and sampling its wares. My contention is that any reasonably good set nowadays, *unless local interference is bad*, should have a repertoire of a round score of foreign stations, all received with clarity.

Actually I have seldom used my most sensitive and selective receiving set for making the records that have formed the basis of these notes. Of set purpose the work has been done with a receiver whose performances are somewhat below the average for to-day. It is a G.E.C. Music Magnet four-valve of the 1930 vintage and is worked from an indoor aerial.

The position on the long waves remains unchanged, but on the medium waves there is a certain amount of news. Athlone's transmissions have been spoilt on one or two recent evenings apparently by wavelength wobbling on the part of Palermo. Milan is badly heterodyned on most nights, and Berlin comes through well only occasionally now. Hamburg, Brussels No. 2, the Poste Parisien, Hilversum, Trieste and Gleiwitz are other heterodyne victims. On the other hand, Strasbourg, Radio Toulouse, and Frankfurt are perfectly clear and good. Recommended stations include Juan-les-Pins, Frankfurt, Bordeaux Lafayette, Munich, Rome, Stockholm, Paris PTT, Söttens, Langenberg, Lyons PTT, Prague, Brussels No. 1, Florence, Vienna, Stuttgart, Beromünster, and Budapest. D. EXER.



A RAPID FLIT. In five days, beginning on February 23rd last, the engineers of Radio-Beograd removed the Marconi transmitter from Belgrade to Makis, 10 miles distant. The photograph shows the new mast ready for the transmission on February 28th.

FOREIGN BROADCAST GUIDE

RIGA (Latvia).

Geographical position: 57° 3′ N; 24° 1′ E.

Approximate airline from London: 1,050 miles.

Wavelength: 514.6 metres. Frequency: 583 kc/s. Power: 15 kW.

Standard time: Eastern European (Greenwich mean time *plus* two hours).

Opening signal (for morning broadcasts): Cock crow.

Standard Daily Transmissions.

G.M.T.: 05.00 (daily), physical exercises; 07.30 (Sun.), records; 09.00 (Sun.), church service; 14.00 (Sun.), French talk; 14.00–19.00, music, talks, etc.; 17.00 (Tues. and Sat.), French talk; 17.30 (Mon. and Thurs.), English talk; 18.00, approx. main evening programme; 20.00, approx., time, weather, news, etc.; 21.00 (Sun., Wed., Sat.), dance music: closes down at approx. 22.00 on Sun., Wed. and Sat. and 21.30 on Mon., Tues., Thurs. and Fri.

Interval signal: Three musical notes.

Call: Hallo! Riga. Announcers: Man and Woman.

Relayed by Madona on 271.7 metres (1,104 kc/s.), 20 kW.

NEW HEPTODE FREQUENCY-CHANGER

The Marconi and Osram M.X.40

THE Heptode is now well established as a frequency-changer in the superheterodyne on account of its manifold advantages over other types. Only one valve is needed, and the tetrode portion may be controlled for A.V.C. purposes, while the coupling between the oscillator and first detector portions is entirely electronic and requires no additional components.

The Osram and Marconi M.X.40 is of the indirectly-heated type with a heater rated at 4 volts 1.0 ampere. The maximum anode potential is 250 volts and the screen rating is 100 volts, while 150 volts may be applied to the oscillator anode. The conversion conductance at a tetrode grid bias of -3 volts is 0.57 mA/v.

Greater efficiency may be secured by operating the valve with a lower screen potential, but this should not be less than one-half the oscillator anode voltage, otherwise a tendency to squegging may occur. Under normal conditions, therefore, the screen potential should not be below 75 volts.

In the oscillator section, a grid leak of 100,000 ohms is recommended, and the grid condenser can be 0.0005 mfd. The self-bias resistance in the cathode lead should be 800 ohms, but, of course, if the cathodes of all valves are commoned, a different value would be needed. The value of 800 ohms applies only when the M.X.40 is independently biased. The makers claim that the oscillator frequency and its peak voltage are hardly affected by changes in the control grid bias of the tetrode portion of the valve; an important point.

New Use for Spare Valves

The Advantages of Diode-Triodes Obtained with Old S.G. or Pentode Valves

IT is not essential to have a special valve in order to obtain the advantages conferred by combining diode detection and L.F. amplification in a single valve. This article shows how a single screen grid valve may be used for these two functions

DIODE detection is now acknowledged to be the correct method. We have been using it for years under the name of grid-leak detection; but as the grid of the valve is then doing two jobs at once—acting as a diode detector and also controlling the rest of the valve as an amplifier—it is master of neither. The result of the detection process is a mixture of the L.F. voltage (which we want to amplify) and a considerably larger helping of H.F. voltage, which we want to keep from going any farther. But when the detection takes place on the grid of the amplifier itself, both sets of voltages are amplified together; and the H.F. part, being the larger, is apt to overload the valve and interfere with both detection and amplification.

So the next step was to use a separate diode valve, follow it with a filter to remove at least a substantial part of the H.F., and then to feed the result to the amplifying valve. There is nothing wrong with the idea, except that it seems a waste to run a whole valve to do what can be done so simply. So this quickly led on to the present multiple valves, in which an ordinary amplifying unit—triode, tetrode, or pentode—has one or two tiny electrodes added, to act as diode detectors. These use the same cathode or filament; but otherwise are independent of the rest of the valve, which can carry on undisturbed.

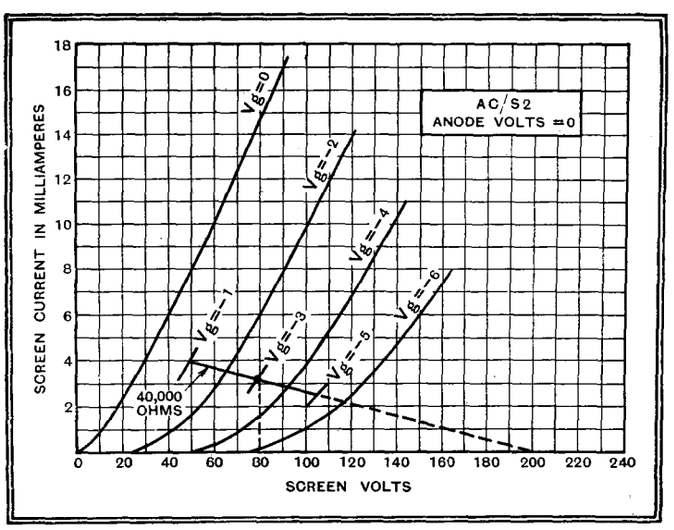


Fig. 1.—Working characteristics of an S.G. valve operated as a triode.

Many readers doubtless would like to try the new circuits, but do not altogether relish the idea of putting down the money for the multiple valve. It is not unlikely, however, that a spare S.G. or pentode valve is already at hand. If so, it can be pressed into service as a diode-triode; a fact which may be sufficiently unfamiliar to justify the following information. An advantage is the remarkably small amount of alteration to connections in changing over from the ordinary grid detector arrangement.

If the screen of either a screen-grid or pentode (H.F. or L.F.) is used as an anode, the real anode being left alone, it behaves as an ordinary triode. Precisely what sort of triode depends naturally on the size and arrangement of the electrodes concerned; but a number of representative valves which have been tested show A.C. resistances of 4,000 to 10,000 ohms, and slopes usually slightly lower than the rated figures for the valves used normally. They are therefore suitable for use with transformer couplings; and, owing to the relatively low internal resistances, the step-up and output are ample for the largest power stages. As modern output valves require but a few grid volts to drive them to capacity, a resistance coupling is adequate in most circumstances.

Four- and five-electrode valves of all types, directly and indirectly heated, can be used more or less successfully—even power pentodes. Fig. 1 shows curves of an AC/S2; incidentally, a very good valve for the purpose. From these it can be seen that the A.C. resistance at a reason-

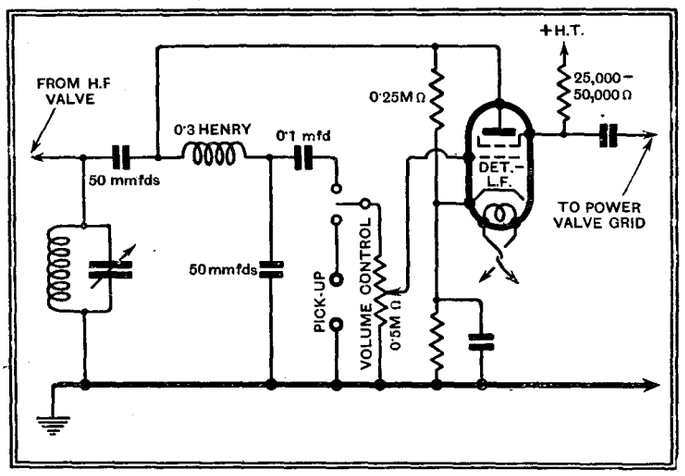


Fig. 2.—An S.G. valve arranged to combine the functions of diode detector and L.F. amplifier.

able working position is about 5,000 ohms, and the slope 35 milliamps. per volt, giving an amplification factor of 17.5. Taking as a typical working point a bias of 3 volts and a current of 3 mA., with a load resistance of 40,000 ohms, and running the grid swing up to only 2 volts peak (to keep quite clear of grid current, which sometimes starts at nearly a volt negative), there is a peak output of 28 volts—enough for most purposes. If it is not (as, for example, for a large push-pull output stage), a transformer, either directly or parallel-fed, can be used; in the former case only 80 volts H.T. is required; giving plenty of allowance for decoupling.

Ordinary Anode as Diode Anode

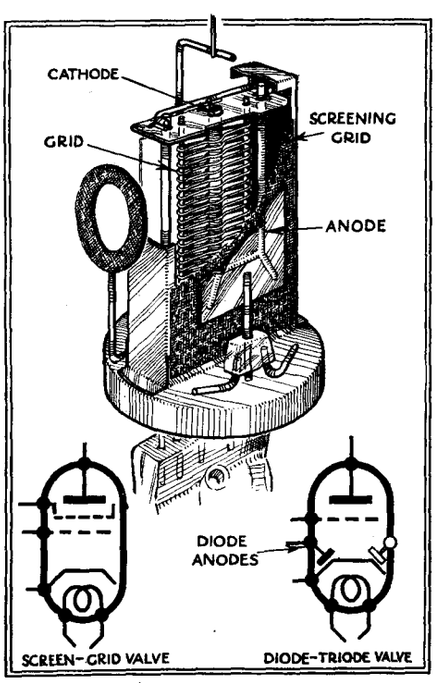
A very different valve—the AC/PEN—when treated in this way gives results which are much the same, except that the slope is rather less.

As for the diode part of the business, the anode is there all ready for use. There are endless circuits that can be considered, and those for which multiple valves are intended can generally be adapted, except that there is no second diode for delaying the application of A.V.C. Plain A.V.C. can be obtained, however; but the main advantage is the

New Use for Spare Valves—

separating of the detection and amplification processes, without calling for an additional valve-holder and all that goes with it.

Fig. 2 is a typical arrangement of the detector-and-amplifier system, when designed to give high-quality amplification; with minimum loss of high notes, yet considerable filtration of even the relatively low radio frequency in a superhet. If the 50-mmfd. condensers are replaced by the more usual 100 mmfd. (0.0001 mfd.) the high notes are very slightly more cut, and H.F. (or I.F.) elimination improved. The volume control may be anything from 0.25 to 1 megohm. If a battery valve is used, the foot of the volume control goes to −G.B., and the "grid" leak (anode leak in this case!) goes to +L.T. The bias resistor, in the cathode lead of a separately-heated valve, is usually 300-1,200 ohms, according to the valve and conditions of working; and should be shunted by a 25-mfd. or 50-mfd. low-voltage electrolytic condenser.



Construction of a screen grid valve. Although the electrodes are differently arranged, they are the same in number as in a diode-triode, and so both types may be used in a similar manner

If the valve that is adapted for these purposes is a variable-mu specimen, there is no reason why it should not be used for auxiliary volume control, particularly if A.V.C. is fitted.

Fig. 3 shows the screen current/grid volt characteristics of a variable-mu valve (MM.4V) compared with the AC/S2; both having zero anode volts and 100 volts on the screen. The innumerable circuits that have been published for all sorts of A.V.C. open up plenty of scope for experiment. An example is given in Fig. 4, where a large input from the secondary of an I.F. transformer is assumed. The D.C. voltage resulting from rectification at the anode is applied through a high resistance to the grid, reducing the L.F. amplification and so compensating, to a greater or less extent, for the inevitable changes in level even after the earlier valves have been controlled. As the maximum L.F. voltage that is likely to be needed is less than that available, the volume control forms only a part of the total resistance. One might try using the amplified D.C. control from the output circuit of the valve; in which case resistance coupling would be necessary.

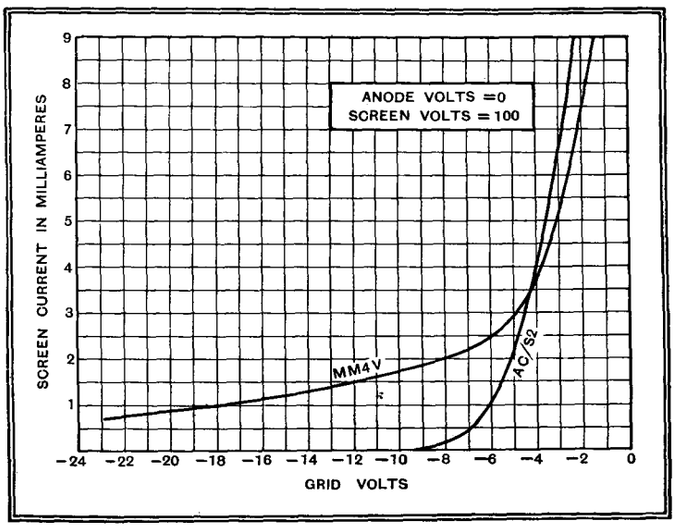


Fig. 3.—Variable-mu and plain S.G. valves compared: both operated with "idle" anodes.

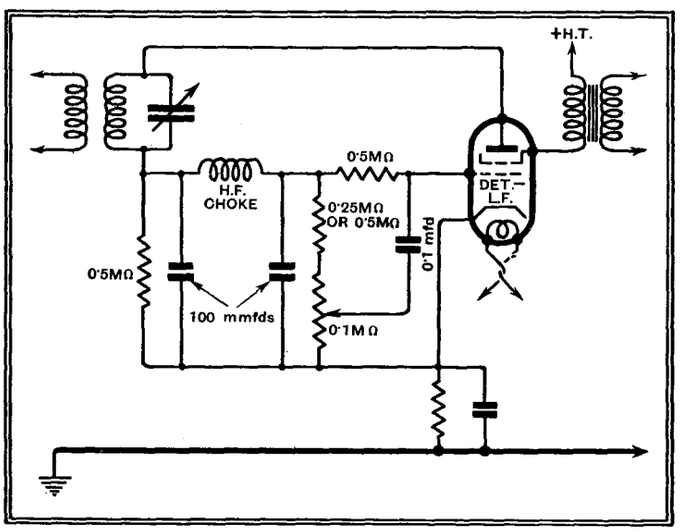


Fig. 4.—Diode detection and A.V.C. effected by an S.G. valve.

THE WIRELESS ENGINEER

The contents of the April issue, published on the first of the month, includes:—

Some Applications of an A.C. Valve Bridge.
Stability of Resistance-coupled Amplifiers.
Direct Reading Harmonic Scales.
Inductance of Screened Solenoids.

also

Abstracts of the World's Technical Wireless Literature.

BOOKS RECEIVED

Short Wave Wireless Communication, by G. W. Ladner, A.M.I.E.E., and C. R. Stoner, B.Sc., A.M.I.E.E. (Second Edition, revised and enlarged.)—A note of the First Edition appeared in our issue of January 13th, 1933. In the new edition additional matter has been included in the chapters on the Development of Short Waves, Electro-magnetic Waves, Propagation of Short Waves, Modulation, High-frequency Feeders, Aerials, and Ultra-short Waves. Pp. 384+xii, with frontispiece, 12 plates, and 215 diagrams and illustrations. Published by Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 15s.

Handbook of Technical Instruction for Wireless Telegraphists, by H. M. Dowsett, M.I.E.E., F.Inst.P., M.Inst.R.E. (Fifth Edition, revised and enlarged.)—Provides a thorough theoretical course for candidates for the P.M.G. certificate and a text book for the use of wireless telegraphists. Among the more important additions to this edition are chapters on Echo Sounding Apparatus, Short-wave Marine Transmission and Reception, Marine Telephony and Band Repeaters. Pp. 572+xix, with 525 diagrams and illustrations and with tables of symbols. Published by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Price 15s.

THE RADIO INDUSTRY

THE National Radio Service Company, of 15, Alfred Place, Tottenham Court Road, London, W.C.1, are now prepared to undertake the supply and installation of car radio receivers. Although this firm is best known for repair work, it has many other activities, including the investigation of acoustic problems and the supply of deaf aids for use in conjunction with wireless receivers. The well-known Brown headphones are being manufactured under licence by the company.

We understand that three Primustatic loud speakers will be used as high-note reproducers in the new Electrona electronic organs which are to be built in this country.

The Motorola Car Radio Receiver, supplied by the Motorola Distributing Co., of 182, Vauxhall Bridge Road, London, S.W.1, is available in several types, at prices between 18 and 30 guineas.

Zenith Radio Service, of 17, Park Street, Guildford, Surrey, specialise in the construction and repair of "Wireless World" receivers.

High Definition Television

Baird Company's Tests with 180-Line Scanning

THE wide frequency band conferred by the use of ultra-short waves is resulting in very considerable improvements in television. Last week's Baird demonstrations are described below

A COMBINATION of business enterprise and technical skill brought the Baird Company's new 180-line television system into the limelight last week. By startling its shareholders with a speech by an absent chairman, whose features were televised as he spoke from the Crystal Palace, eight miles distant, the company also intrigued the world.

A photograph which does less than justice to the received image. The picture appears in a pleasing sepia tone on a cream base.

At subsequent demonstrations at Film House, Wardour Street, we were able to confirm the justness of the claims made for the new system. The received picture is remarkably steady, yields a satisfying gradation of light and shade, and is practically flickerless.

Wide Range Amplification

Transmission is effected on ultra-short waves from the South Tower of the Crystal Palace, the transmitters themselves being located at the base, with two sets of feeder lines to the di-pole aerials at the top. At the moment highly directional aerials are used. Vision is transmitted on 6 metres and sound on about 6.25 metres. Scanning is electro-mechanical, and the equipment includes what are stated to be the largest and most powerful photocells in the world. The amplification system is of special interest, the engineers claiming that it has a flat frequency response between 25 and 800,000 cycles.

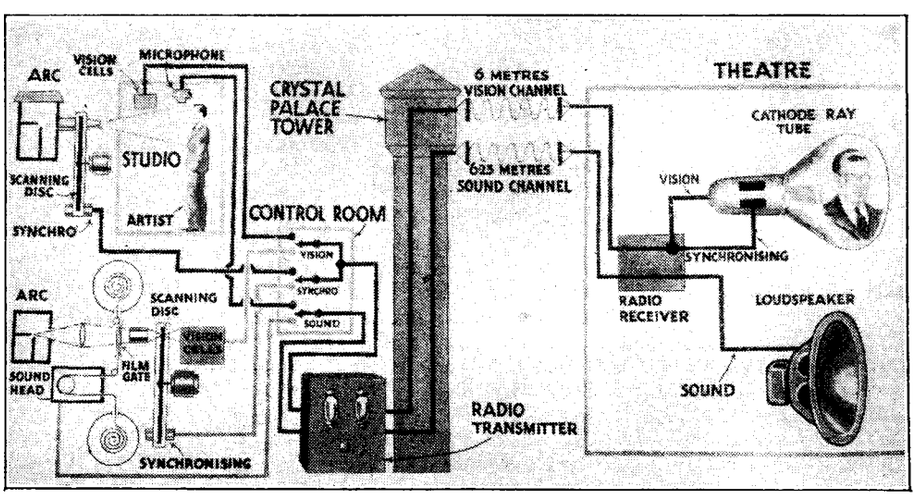
With commendable courage the company has chosen one of the worst sites in London for the ultra-short wave receiver. Surrounded by intermittently functioning electrical apparatus, such as neon signs and traffic signals, the receiver provides an image in which interference effects are almost entirely absent. Visible static during the demonstrations was almost entirely confined to the occasional horizontal white lines created by a telewriter in the same building. Another conflicting factor is the building's D.C. supply, all current for the receiver having to be derived *via* a rotary converter.

The cathode ray tube in the demonstration receiver is 4 feet long and gives a screen diameter of 12 inches, the actual picture measuring 10 by 8 inches. The images are seen in a pleasing sepia tone on a cream base. The 180-line scanning provides 25 frames per second, as compared with 24 frames in the case of talking pictures. It is interesting to note that in 30-line television as conducted by the B.B.C. there are only 12½ frames per second.

Synchronisation, which appears to give no trouble, is automatically controlled from the transmitter, and there are no moving parts in the receiver.

The best testimony to the success of the demonstrations lay in the fact that successive audiences could forget the television medium in the interest created by the programme itself. Transmissions of talking films were particularly convincing. Incidentally, we understand that no other organisation in the world is at present conducting 180-line television of artists in person.

The vision aerial on the south tower of the Crystal Palace. Behind the di-pole aerial is the reflector. A feeder line connects through to the transmitter at ground level.

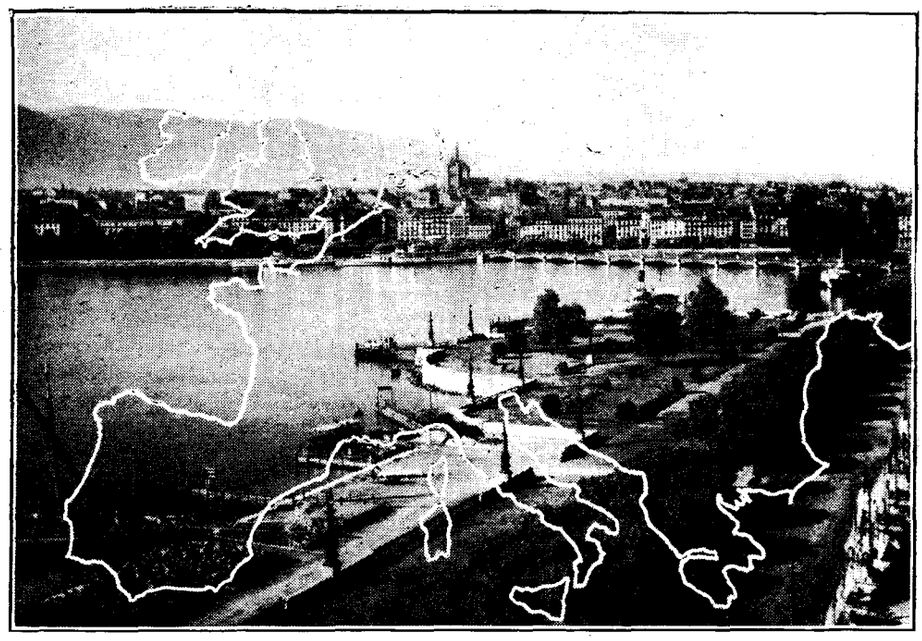


A schematic diagram showing the principal features of the demonstration arrangements.

"U.I.R."

The International Broadcasting Union at Home

By CECIL W. LUSTY



The City of Geneva, where the International Broadcasting Union holds a watching brief on behalf of Europe's 70,000,000 listeners.

THE fogs of London seemed thousands instead of hundreds of miles distant when, in the cheering February sunshine, I sauntered down the graceful Rue du Mont Blanc, crossed by bridge the crystal-clear lake of Geneva, and made my way along the tree-flanked Cours des Bastions.

No modernistic palace of broadcasting rewarded my search; instead—in appropriate keeping with the unostentatious nature of this important body—I found the headquarters of the U.I.R. in an old-world grey building bearing in unassuming letters the inscription "Union Internationale de Radiodiffusion." The building was formerly a bacteriological laboratory.

A few minutes later I was greeted by Mr. Arthur Burrows, Secretary-General of the Union, and formerly B.B.C. Director of Programmes—or as I, and probably all old *Wireless World* readers, prefer still to envisage him—"Uncle Arthur" of Savoy Hill.

A telephone call from another country engaged Mr. Burrows' attention—the lot of director of the Geneva bureau is essentially a busy one—and while waiting I glanced round the quietly furnished office. The walls were covered with charts of statistics and maps of Europe.

The Secretary-General, Mr. A. R. Burrows, "snapped" outside the Union's offices in the Cours des Bastions.

Mr. Burrows, in the same everyday manner that the Control Tower official at Croydon Aerodrome unhesitatingly points to a map and locates a particular aeroplane, showed me how one European country could be put without delay in contact with another by means of the elaborate system of relaying circuits. This annihilation of distance has largely been due to the efforts of the Union.

Mr. Burrows mentioned that when the Union was born nine years ago there were practically no international telephonic circuits suitable for the relaying from country to country of musical programmes. The Union (acting through the International Consultative Committee on long-distance telephone communications) drew the attention of the State Telephonic Administrations to the importance of providing international circuits capable of carrying musical frequencies. To-day there are but few countries in Europe which cannot participate effectively in an international relay.

How the Union was Born

The Union had its genesis in 1925, and since then has done yeoman service in aiding the perfection of modern broadcasting. The necessity of some central body to solve the problem of ether congestion—a problem that became increasingly acute with the rapid growth in the number and power of transmitters—was first recognised by Great Britain and Switzerland, and the former convened an international gathering at Savoy Hill in March, 1925. The foundation members of the Union, the constitution of which was framed at Geneva a month or two later, were Great Britain, Holland, Belgium, France, Germany, Switzerland, Austria, and Spain.

The present popular president, Vice-Admiral Sir Charles Carpendale, Controller of the B.B.C., was elected president, Ministerialrat H. Giesecke (Germany) and M. R. Tabouis (France) vice-presidents, and Mr. Burrows was appointed secretary-general. A technical committee was formed under the chairmanship of Captain Eckersley (then of the B.B.C.), and with the expansion of the Union's activities judicial liaison and relay committees were later formed.

LITTLE-KNOWN facts concerning the inner workings of the Union Internationale de Radiodiffusion are set forth in this article, the author of which recently visited the headquarters of the Union at Geneva. Mr. A. R. Burrows, the Secretary-General, won fame as "Uncle Arthur" in the early days of British broadcasting and was the first programme director of the B.B.C.

As broadcasting grew in importance and scope, so did the Union. To-day it has twenty-five full members, including Egypt and Algeria, besides a number of associate-member countries, such as far-distant Japan and Australia. In Europe Bulgaria and Greece are not members, but these countries, as explained in my article, "Programmes from the Near East" in *The Wireless World* of January 5th, are backward in broadcasting progress. This, of course, does not in any way prejudice their claims to membership of the Union, and it is hoped that they will later take their place in the federation of broadcasting.

Each country is entitled to representation on the council of the league, which usually meets three times a year, there being an annual general assembly in June. This year the assembly will be held for the first time in London. Countries such as Yugoslavia, where broadcasting is not under the control of a central organisation, the stations being conducted by separate societies, choose their delegate by internal agreement. Membership countries pay an annual subscription for the maintenance of the Union — whose accounts, incidentally, have never been on the wrong side of the ledger—and there is a reduced fee for associate-members. The latter receive helpful information periodically, and may attend the General Assembly.

"U.I.R."—

The specialised work of the Union is carried out by the four committees which meet when occasion demands, and on which all member countries may be represented. It is gratifying to note that the work is not left to a few pioneering countries, but that the personnel is very representative. The chairman of the technical committee is M. Raymond Braillard, (Belgium) who has ably filled the position since 1926. M. Braillard is director of the Union's research and frequency checking station at Uccle, Brussels. This phase of the Association's work has special interest for the listener, as the committee has done much to help reception by improving transmission technique.

The Law of Copyright

The judicial committee finds a capable leader in Dr. Sourek, head of "Radiojournal," the Czechoslovak Broadcasting Organisation. Dr. Sourek has carried out this duty since the inception of the committee. This group studies the international legal problems of broadcasting and is seeking international recognition of a property right in the programmes as broadcast. At a recent meeting the legal committee commenced an examination, from the broadcasters' point of view, of the proposals to be put forward at Brussels for the revision of the Berne-Rome Convention on the rights of authors. The Union receives reports of all law proceedings regarding, for example, broadcasting of gramophone records, interference from electrical apparatus, neighbours' rights in regard to noisy loud speakers during unconventional hours, outdoor aerial restrictions and so on. This information is published in the monthly bulletins, printed in English and French, which are supplied to member and associate-member organisations. The data is carefully indexed and filed, and is instantly available upon request.

International Programme Exchange

M. Dubois, chairman of the central group of the Dutch Broadcasting Organisation, presides over the liaison committee, which concentrates on the artistic and programme side of international broadcasts. English listeners have enjoyed some fine relayed programmes from foreign stations. The preparation of these has been assisted by the Union.

The Union's ramifications also cover the collection of statistics of programme building in various countries, and the mature advice it can offer in this respect is of great assistance to new broadcasting concerns. The Geneva Office issues periodically to the members of the Union lists and brief accounts of new and successful radio plays and of new music specially written for broadcasting purposes.

The fourth committee forges a vital link with the listener as it is concerned with arranging for international relays of programmes. M. Chamiec, head of the Polish Broadcasting Authority, is in charge of this body. In 1925 the successful relaying of a Munich programme to Zurich was hailed as a notable achievement; in 1928 the relaying of a New York talk by Dr. Eckener, Commander of the Graf Zeppelin, marked another radio milestone; to-day the Christmas greetings of King George V are heard throughout the world. The co-ordination of broadcasting effort and the establishment of good will and understanding between the various organisations is largely the handiwork of the Union, and has contributed in no small degree to this astonishing advance in relay technique.

But the activities of the Union do not stop here. It is in close contact with various organs of the League of Nations, such as the Transit and Communications and the Intellectual Co-operation committees, the International Labour Bureau; the International Institute of Intellectual Co-operation; the European State Administration of Posts and Telegraphs; the American National Advisory Council on Education in Broadcasting; the International Red Cross; and the Union Internationale des Secours.

The Tower of Babel

The Geneva office has a specialised staff of capable linguists, and all are kept busy dealing with the great mass of correspondence, the preparation of the bulletins, the compilation of statistics and the translation of documents. The Union has the services of a linguist who can translate over a dozen languages, not excluding Arabic.

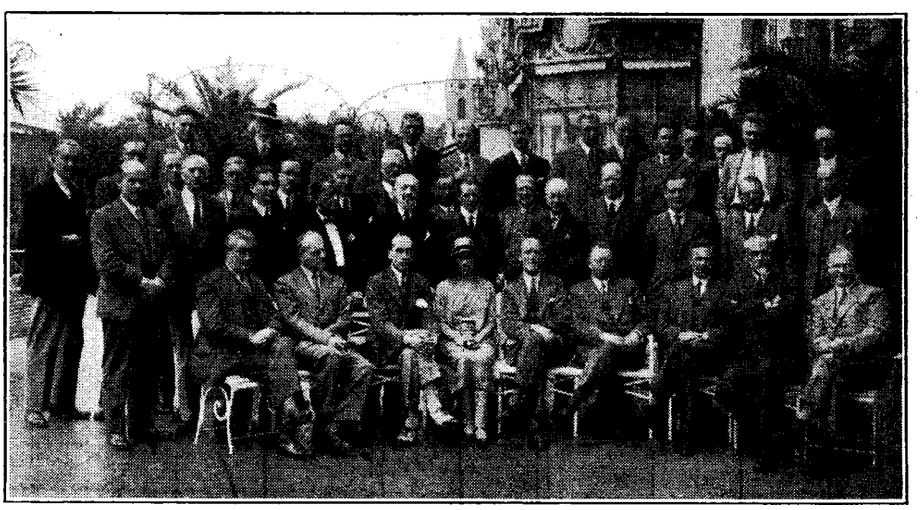
Although Mr. Burrows now has no "fan" mail, as when he was a microphone personality, he receives many letters, some containing criticisms of the organisation, some constructive and more destructive. Callers are relatively few. However, on one occasion Mr. Burrows was asked if his office was an establishment for reducing surplus weight and fat by X-ray processes. This appears to be one of the few activities outside the scope of the Union.

The "U.I.R." has been likened in some quarters to the "policeman of the ether," and as such has been taken to task for its apparent failure in dealing with refractory stations and making the punishment fit the crime. Some listeners, pointing to the fact that the broadcasting of political propaganda still continues, contend that the Union is a failure, being powerless to exert its authority. The allegation is unjust. In one sense, the Union is an unofficial "policeman of the ether," but it contents itself with being a traffic policeman.

What of the Future?

It makes no claim to be an arbitrary body or a symbol of the mighty power of the law; indeed, such a notion is diametrically opposed to its principles. It believes that the power of international understanding and good will is the most potent weapon, and it therefore dedicates itself to the fashioning of a world fraternity of broadcasting, of a confederation of nations bound together by ties triumphing over barriers of tongues, racial prejudices and inherent misunderstandings.

As an already indispensable adjunct to European broadcasting, the Union will increase in importance proportionately to the universal growth of broadcasting. The National Broadcasting Company of America and the Columbia Broadcasting System of America are associate-members, and it is hoped that the Canadian Broadcasting Commission, the South African Broadcasting Company and the New Zealand Broadcasting Commission will join the international movement now that radio services are being well developed in their countries. And given the inclusion perhaps in the future of South American broadcasting concerns the Union might become the world's "radio" mouthpiece.



A typical meeting of the Union, held at Montreux, Switzerland. Admiral Sir Charles Carpendale, the President, is in the centre of the front row. On the extreme right of the row is Mr. Burrows and on the extreme left M. Braillard. Standing to his right is Mr. Noel Ashbridge, Chief Engineer of the B.B.C.

Practical Tone Correction

Part I.—Compensating for Loss of Sidebands

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

AN attractive method of obtaining high selectivity combined with good quality is to use extremely efficient tuned circuits in conjunction with compensation for loss of high notes. Much practical information on this subject, and on the allied problems of variable tone control, is given in this article.

DURING the last few years there has been an increasingly sharp conflict between the requirements of selectivity and those of tone quality. Even non-technical listeners realise that the chief difficulty under present conditions is not to bring in the desired programme but to keep the others out. Continual increases in the number and power of stations have called forth corresponding improvements in selectivity.

According to the Lucerne Plan, stations in Europe are spaced 9 kc/s (9,000 cycles per second) apart. If they were all "standing by," with their carrier waves switched on but no audible programmes being transmitted, there would be clear, undisturbed gaps of 9 kc/s in between each station. During the transmission of programmes, however, continually fluctuating side-frequencies are radiated, and with present-day microphones these are liable to extend to about 8 or 9 kc/s each side of the central carrier wave frequency. Assuming 9 kc/s as the top limit, it is obvious that the side-bands of each station completely overlap those of the two stations next to it in frequency.

Theoretically, then, even a perfect receiver could give complete reception of the wanted station and complete exclusion of all others only if the audible frequencies from each station were restricted to a maximum of 4.5 kc/s. In practice it is impossible to devise a tuning system that accepts everything fully, just up to 4.5 kc/s each side of the frequency of a station carrier wave, and then cuts off sharp like a knife, however greatly advertising matter may appear to suggest the achievement of such an end. Even the best-contrived band-pass system fails to give a perfect square-topped resonance curve, and most of those that are actually obtained come very far short of that ideal.

So we see that in theory at least one cannot have a perfectly selective receiver that reproduces audible frequencies over 4,500 cycles per second, and practical limitations might seem to bring the top limit even lower, which would mean a very poor standard of reproduction indeed.

It is a fact that the reproduction of modern selective sets is much worse than it ought to be, just because of this overcrowding of stations; but that because a good range of audible frequency is radiated it is possible to get very satisfactory reproduction from stations which are overwhelmingly near or powerful by accepting everything they have to give, nearly up to the 9 kc/s limit. There is likely to be interference from even a weak station, due to its carrier wave, 9 kc/s away, heterodyning that of the wanted station; so it can be taken for granted that the receiver cut-off should take place short of that limit. But the heterodyning of the interfering side-bands with the wanted carrier wave is fortunately not very disturbing unless the interfering station is relatively strong. The side-bands are weak, less continuous, and more widely distributed than the carrier wave. This is fortunate; for, as will have been seen from the foregoing, a receiver giving a guaranteed exclusion of interference would exclude substantially the whole of the wanted programme!

There is still the difficulty that receiver acceptance up to nearly 9 kc/s would bring in practically the whole of the neighbouring side-bands as a background of interfering programme (as distinct from unintelligible heterodyne mutterings). This difficulty is largely alleviated by a principle that most sets now take advantage of to a greater or less extent—tone correction. It is now well known that if both "wheat and tares" are cut down drastically by means of a very sharp tuning system, and the frequencies making up the desired programme are subsequently restored by amplifying them up to make good the loss due to tuning, the interference is not restored by a corresponding amount, and therefore is in effect reduced.

Interference between Sidebands

These matters are shown diagrammatically in Fig. 1. The carrier-wave frequency of the wanted station is represented as 0, and the frequencies of the two neighbouring stations as −9 and +9 kc/s. If there is no selectivity at all (*a*) everything put out by the desired station is faithfully received. So also is everything put out by every other station: hence this method is not followed. In (*b*) we have a theoretically perfect arrangement for avoiding all interference except one set of side-bands from each of the two stations nearest in frequency. A typical practical approximation to this is shown at (*c*), which represents the result of a band-pass system. The upper wanted frequencies are considerably whittled away. An alternative is to use relatively broad tuning, and to employ a special audio-frequency filter to cut out the interference (*d*). A filter may also be used to augment the cut-off obtained by a band-pass system. Curve (*e*) is the result of sharply peaked tuning, which is intolerable without tone correction. Up to a fairly high audible frequency the correction should be the exact opposite of the tuning curve, so that when the two are used together the result is straight-line reception; but in order to avoid bringing up whistles the rising correction should cease at some point below 9 kc/s. An ideal correction curve is thus something like (*f*).

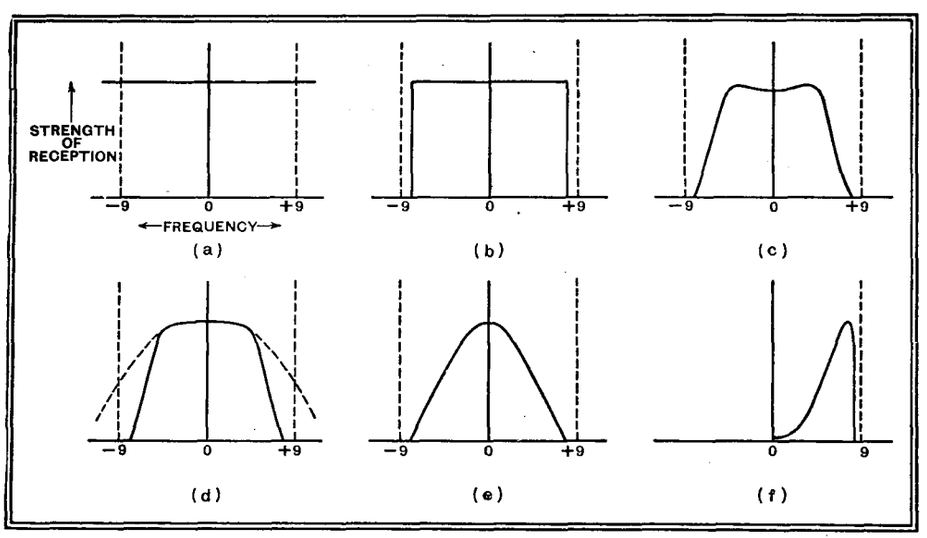


Fig. 1.—Illustrating the principles of adjacent-channel selectivity.

Practical Tone Correction—

We can see from this that there is scope for several possible types of tone correction, in order to bring the final result as near Fig. 1 (*b*) as possible.

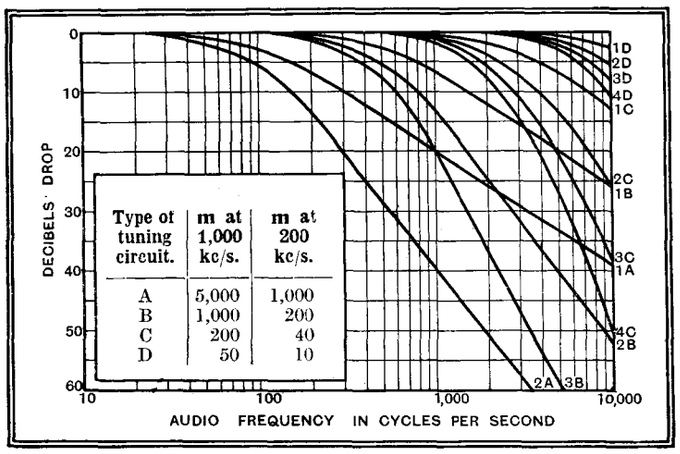
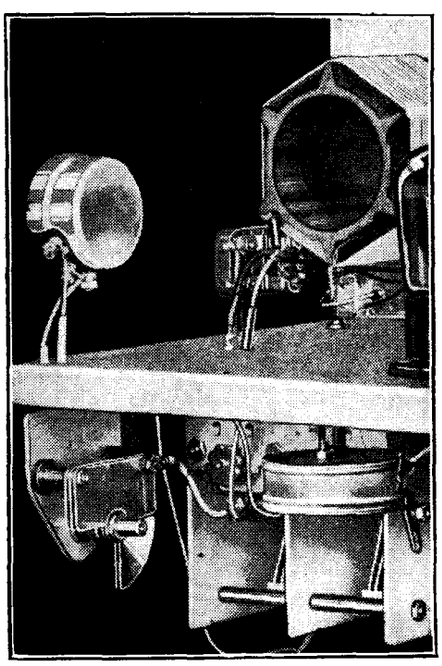


Fig. 2.—High-note loss due to various types and numbers of tuned circuits.

There is another closely allied subject which may be distinguished as tone *control*. Although it has been argued that a perfect reproduction of the original is right, and any alteration of the balance of tone is wrong, the fact remains that it is extremely useful to be able to alter the tone. In fact, the chief reason why tone controls are not universal is that most of them are so very bad. They might be compared with a barometer marked at one end of the scale "Wet," and at the other end "Very wet." The usual arrangement is simply a more or less variable condenser which cuts off the already weakened high notes. A true tone control should give a "tilt" in either direction; after having already obtained a fairly level result, either by tone correction or by some other system, such as band-passing.

Tone control helps to compensate for variations in the acoustics at either transmitting or receiving ends, or to mitigate the imperfections of loud speaker and other components (after all else has been done to make them as good as possible), or to correct the disturbed balance of tone caused by reproducing a programme at a loudness greatly different from that of the original. Though it has nothing to do with selectivity, it is convenient to consider it along with tone correction because the technique is so much the same.



A section of the "Autotone" receiver, in which full use was made of the principle of selective tuning and tone compensation.

The first thing is to get some definite ideas as to what it is that has to be corrected. Band-pass systems may give curves of all sorts, and in any case are an attempt to do without tone correction. But fortunately the ordinary single tuned circuit has quite a definite fixed shape, even when the sharpness varies. This is true only if it is drawn with logarithmic or decibel scales, which should always be used, if for no other reason than that they give a picture which corresponds closely to the actual results as understood by the ear. The only effect of increasing the sharpness of tuning is to shift the curve bodily to the left, and vice versa. The effect of using more than one tuned circuit can be found by adding together the figures on the vertical scale relating to each circuit.

To show at a glance how much side-band cutting is caused by various tuning systems, the fundamental curve has been shown in various positions in Fig. 2, which also displays the added effects of up to four tuned circuits.

The sharpness of tuning is conveniently expressed as the "magnification," **m**. So far as side-band cutting is concerned, the **m** has to be proportional to the frequency of the carrier wave in order for the sharpness to be constant. For example, a really good litz-wound air- or iron-cored tuning coil may have an **m** of about 200 at 1,000 kc/s (300 metres wavelength), but the corresponding coil for tuning to 200 kc/s (1,500 metres) should have an **m** of only 40. The sharpness usually varies somewhat when a coil is tuned by a variable condenser; it is therefore a great advantage of the superhet that the principal tuned circuits work at a fixed frequency, and so can be compensated by a fixed tone corrector.

The four different types of coil referred to in Fig. 2 are distinguished by letters A to D, and the number of such circuits in use is indicated by the figure; curve 3C thus refers to a combination of three tuned circuits each having an **m** of 200 at 1,000 kc/s. It is quite easy to combine any of the curves shown, to show the effect, say, of a set having one C circuit and two D circuits. It is assumed, however, that there is no coupling between any of the circuits: band-pass systems are thereby ruled out.

C, as already explained, represents the best type of coil likely to be used. A single circuit of this type causes a loss which is appreciable only above about 4,000 c.p.s., where the average commercial receiver cuts off steeply. The drop at 9,000 c.p.s. of 12 db. is quite inadequate selectively. Circuit D is made up of the worst type of coil commonly found. Even four such circuits fail to give much selectivity, but, of course, the loss of quality is also almost negligible.

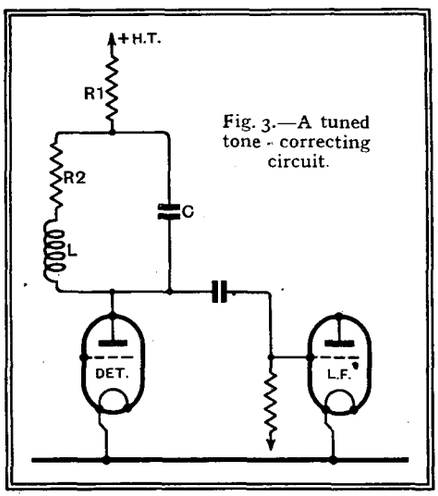


Fig. 3.—A tuned tone-correcting circuit.

B cannot be obtained, on medium waves at least, by any practicable coil construction; but it is quite easily got by ordinary reaction. It is perhaps also just *possible*, without reaction, in a superhet I.F. transformer, where an **m** of about 110 (at 110 kc/s) is involved. Curve A is obtainable by extreme use of reaction, such as in the "Autotone," described in *The Wireless World* a year or two ago.

Advantages of Multi-circuit Tuning

It will be noticed that the curves relating to any given number of circuits are all of the same shape, and are different only in position. Incidentally, Fig. 2 shows very clearly how it is much better to use many flat circuits than one sharp one, if there is to be no tone correction. Compare 1A with 4C, which is more selective, yet does far less damage to the audible frequencies.

From Fig. 2 we see that the tone corrector should give a rising curve that goes up slowly at first, and then at a constant steepness. The frequency at which it should begin depends on the sharpness of tuning; and the steepness of correction depends on the number of tuned circuits.

Practical Tone Correction—

The simplest and commonest system is to use as an intervalve coupling a choke coil of relatively low inductance (usually about 0.3 henry) in series with a resistance. The frequency characteristic rises at just the same rate as the straight part of the selectivity curve falls, and so gives perfect correction; the gradual easing off at the low-frequency end is controlled by varying the resistance.

If it were not for other effects, such as by-pass condensers, or the failure of loud speakers to reproduce very high notes, such a tone corrector might bring back an unpleasantly large amount of whistle by continuing the correction up to too high a frequency. It is, therefore, desirable to limit the correction to some frequency lower than 9 kc/s, depending on the severity of interference. If the corrector then cuts off sharply, it assists the cut-off due to H.F. tuning, and helps to get near the ideal of Fig. 1 (*b*).

A convenient way of doing this is to tune the choke coil (L) with a condenser C. This modified circuit is shown in Fig. 3. Here it is seen that we have four variable quantities to consider instead of two, and consequently the choice of suitable components is a little less simple. In practice, however, it is possible to eliminate one of them.

Various Forms of Correction

Without going into full details, which are rather mathematical, the effects of varying the components in the tone-corrector circuit can be stated thus:—

(1) The *height* of the peak which is made equal and opposite to the depth of the appropriate selectivity curve, such as in Fig. 2, at the cut-off point, is controlled by R2. As R2 is reduced the peak rises.

(2) The *position* of the peak is controlled by the product LC (L multiplied by C). Actually it should be fixed at a frequency rather lower than that at which it is desired to cut off, because it does not begin to fall away rapidly at first. Thus, for a cut-off at 5 kc/s, the peak may be located at 4 kc/s.

(3) The *breadth* of the peak is controlled by the ratio L/C. There are any number of values of L and C that fulfil any required condition for (2) alone, and to fix them definitely this further requirement has to be considered. If L/C is too small the peak will be too narrow, and while giving an excellent cut-off will tend to cause a hollow at the medium frequencies.

(4) The tailing off at the low frequencies is controlled by R1, and to some extent by R2 also, so that in most practical cases R1 can be omitted altogether, and R2 relied upon to perform both functions. This is the control that compensates for varying degrees of selectivity.

The above effects are shown diagrammatically in Fig. 4, indicating the combination of H.F. tuning and corrector. If the corrector in use fails to meet with conditions in any respect this will give the clue to the remedy.

In a typical tone corrector of this type, L is 0.3 henry, C is 0.005 mfd., and R2 is 2,000 ohms. This is suitable for correcting a single tuned circuit of the Autotone type, having a magnification

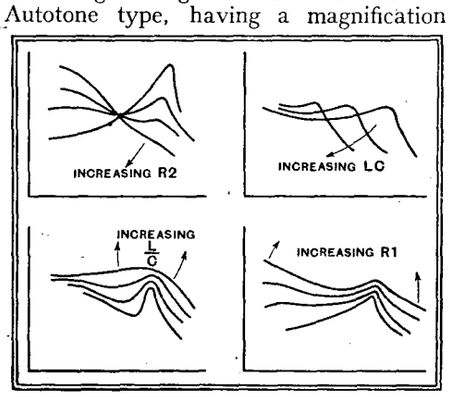


Fig. 4.—Effects of varying the constants of a tone-correcting circuit.

(**m**) of about 1,000, and in which it is desired to keep audible frequencies level up to 5 kc/s and to cut off thereafter. In order to cope with the varying tuning conditions R2 should be variable; a 0-5,000 ohm control is quite suitable. In all cases R2 includes the resistance of L, which can be a H.F. choke of the right inductance.

A disadvantage of this type of corrector is that at low frequencies it constitutes a relatively small impedance in the anode circuit of the valve. Usually one aims at making the impedance of the coupling large compared with the valve's own resistance, partly to extract as much amplification as possible from the valve and partly to minimise the curvature of the valve characteristics, which causes harmonic distortion. If the impedance of the coupling falls well below the A.C. resistance of the valve, then there is serious harmonic distortion when any attempt is made to apply the full normal signal voltage to the grid. It is, therefore, quite important to remember that a tone corrector stage cannot be counted on to give a large output. True, it is possible to devise systems with the desired characteristics which do not fall to a low impedance; but they are apt to be rather awkward and complicated if they are really effective.

Several things can be done to help steer clear of this danger. First, the tone correction should be done as soon after detection as possible, while the signal is small—that means in the anode circuit of the detector valve. Secondly, the valve should have a high mutual conductance; the object being to obtain a large amplification with a low valve resistance, so that only a small signal need be applied to a valve which can normally handle a fairly large one. Thirdly, the coupling itself should give a step-up—in other words, a transformer should be used.

(*To be concluded.*)

New Universal Valves

Mullard Range With Pinless Bases

A NEW range of indirectly heated valves with marked departures from normal practice has been announced by Mullard. There are six valves, of which one is a rectifier, and they are all characterised by their heater ratings, for the current consumption is 0.2 ampere in all cases. With the exception of the rectifier and the output

pentode, the valves are rated for 13 volts. The pentode requires 26 volts, however, and the rectifier 20 volts. The valves are intended for universal operation, and may consequently be used on A.C. or D.C. at will.

The S.P.13 is an H.F. pentode of the non-variable-mu type, and has a mutual conductance of 2.4 mA/V., while it is rated for 200 volts anode and 100 volts screen potentials. The V.P. 13A is a valve with the same voltage ratings, but it is a variable-mu H.F. pentode with a mutual conductance of 2.5 mA/V.

Perhaps the most interesting valve of the range is the F.C.13, for this is of a type not found in any other heater rating. It is an octode frequency-changer—that is, it is similar to the heptode, but the first detector portion is of the pentode type instead of the tetrode.

The detector valve is the 2D.13, and is a simple duo-diode, and the range of receiving valves is completed by an output pentode, the Pen.26. This has a mutual conductance of 6.0 mA/V., and is rated for 8 watts anode dissipation. The last valve in the series is the rectifier. This is of the half-wave type, and is rated for an output of 75 mA and a maximum input of 250v. R.M.S.

The most striking feature of these new valves is their bases, for the familiar pins are not used. Instead, the bases carry a number of metal contacts which press against suitable tongues in the special holder. Another unusual point is the provision of a top-cap for the control grid connection in all valves, and not the frequency-changer only. A reduction in the physical dimensions of the valves has also been made. The copper metallising of Mullard valves is well known, but for these it has been abandoned in favour of gold metallising, so that in all ways the appearance of these valves is unusual.

The valves are not yet available for general use, and we understand that no release date has yet been fixed. The details which are so far available, however, are indicative of a new trend in valve design which is not without technical merit.

News of the Week

Current Events in Brief Review

The Silent City ?

THE City of London Corporation is seeking approval by a by-law making it an offence to cause annoyance by wireless loud speakers and gramophones.

No More Crackles

THE French anti-static law comes into force on Sunday next, April 1st. After that date persons causing interference to broadcast reception will render themselves liable to prosecution.

Now Then, Luxembourg !

ACCORDING to the latest rumour, the Soviet Government intends to build a broadcasting station with a power of 1,200 kW. This power exceeds that of all the British stations combined.

Record Broadcasting

ITALY is the country of broadcast gramophone records. Statistics prepared for the year 1933 show that 300 records were broadcast daily, or, taking into account the ten Italian stations, a minimum of thirty discs per station per diem.

A Million Sets

SALES of British radio apparatus, including valves and components, totalled £22,500,000 during 1933 and gave employment to at least 75,000 people. These facts are disclosed in the 500th number of *The Wireless and Gramophone Trader*. Nearly a million British sets were sold, their value totalling £14,092,000; 523,000 mains sets were sold, as compared with 376,000 battery receivers. In 1929 the average price of a mains set was £24; in 1933 the figure had fallen to £15.

Distance Lends Enchantment

ON another page appears a description of the television demonstration given by the Baird Company on March 23rd. Two days earlier, history was made at the company's fifth annual general meeting, the chairman, Sir Harry Greer, delivering his address while being clearly televised from the South Tower of the Crystal Palace. In the course of his speech the chairman said that the company was in a position to transmit a programme from the Crystal Palace to cover the whole of Greater London, and, by the company's association with the Gaumont-British Corporation, to provide for an unrivalled list of artistes.

Photographers, Note !

THOSE of our readers who include photography in their list of pastimes will be interested in a scheme by which our sister journal, *The Amateur Photographer*, is supplying a Watkins exposure meter to its readers at a nominal price. Full particulars will be found in the current issue.

Castles in the Air

THE possibility of 250-kilowatt transmissions from Algeria was envisaged by a committee which sat last week in Algiers to discuss the future of *Radio-Alger*. It was decided to instal a transmitter capable of a maximum output of 250 kW. to "extend Algeria's range to all Western Europe." The aerial towers, of which there will be at least two, will be 700 feet high.

A Quick Starter

THE technical editor of our German radio contemporary, "7 Tage," has just published details of a quick starting invention which "will come as a boon to all those set manufacturers who want to give their public the added value of being able to listen within a few seconds after switching on a mains set." To avoid the wait of between thirty and seventy seconds now required to heat up the cathode element, the inventor gives the heater a voltage of 7 instead of the usual 4 for a few seconds. Immediately the electron emitting temperature has been reached, a thermal contact switches the voltage down to 4. Thus reception starts after not more than seven or eight seconds.

At present the invention has not passed the theoretical stage, and we look in vain for any comment on the possibility that quick starting may shorten the life of the valve. Nor does the inventor say what happens when the thermal contact sticks.

Passion Play Broadcast

THE famous "Passion Play" of Oberammergau is to be broadcast this year, the first transmission taking place on May 21st.

Broadcasting House for Holland

THE oldest Dutch broadcasting company, the A.V.R.O., is erecting a large new studio building at Hilversum. The foundation stone was laid a few days ago.

The Listener's Vote

WIDESPREAD interest has been aroused by the announcement that Dr. Nevil Hopkins, a New York scientist, has elaborated a device for recording the opinions of wireless listeners.

In principle, Dr. Hopkins' device depends upon the measurement of increased electrical impulses on a galvanometer which would be used by those listeners, now in the majority, who own mains sets. The doctor's theory is that if an announcer requested listeners to "press the knob" at a given moment the slight change in current drain on the electrical system would suffice for a mathematical calculation of the number of listeners at any given time.

Dr. Hopkins believes that wireless sets of the future may be manufactured with the vote recorder as part of the standard equipment.

Imported Valves

THE Board of Trade announces that an Order in Council was made on February 26th last, under the Merchandise Marks Act, which requires that indication of origin shall be shown on imported thermionic valves dissipating a dead loss at the anode not exceeding 50 watts. The Order also applies to rectifying valves not exceeding a capacity of 60 volt-amperes or passing a current of more than 1 ampere. The Order comes into force on May 26th next.

The Vexed Question

THE reduction of interference is one of the main points in the table of questions to be discussed by the International Consultative Committee of Radio Communications, which is to meet shortly in Lisbon.

A Modern Studio

NO wall hangings, no carpet, and movable microphones are features of the new studio of the Alpes-Grenoble station, described as the most modern State broadcasting station in France. The walls are composed of wood fibre, the thickness being varied to suit the acoustic conditions.

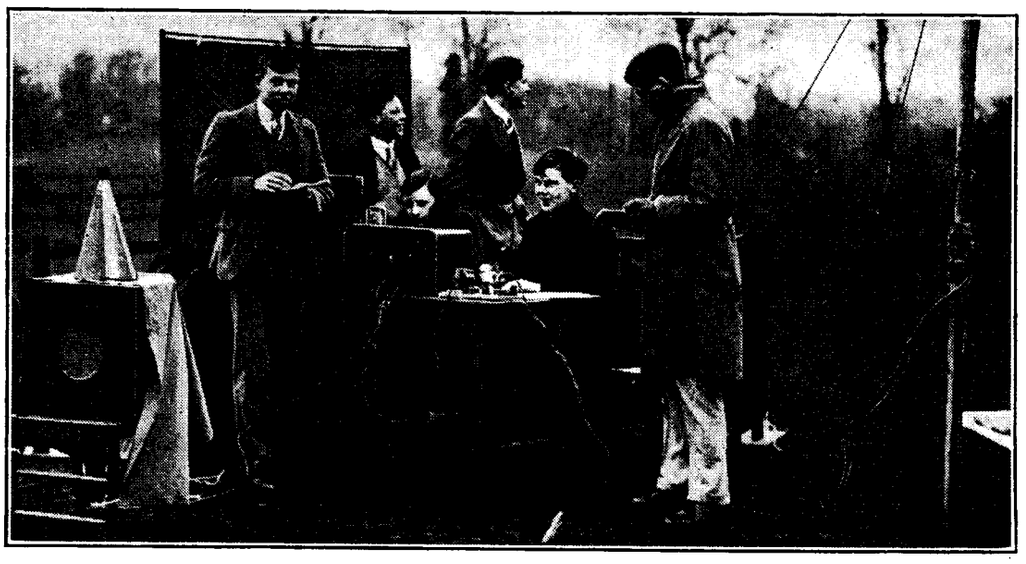
U.S. Combs the World

DURING 1933 the American broadcasting stations relayed sixty-seven programmes from Great Britain. During the same period twenty-seven programmes were relayed from Germany, eleven from France, six from Italy, and five from Switzerland. Russia contributed four, while India and Japan each supplied two programmes.

High Power in Roumania

TECHNICAL details are now available of the two new transmitters which the Roumanian Broadcasting Company has recently ordered from the Marconi Company. One is of the "super-power" class, with an aerial energy of 150 kilowatts, and the other of 20 kilowatts aerial power.

The 150-kilowatt transmitter is adaptable to operate on any wavelength between 1,030 and 2,140 metres, and its power may be increased at a later date without undue complication to an aerial input of 300 kilowatts, if considered necessary.



INGENUITY ON THE SPORTS GROUND. Sixth-formers at the Leys School, Cambridge, final sports rigged up this public address system with the aid of a mains set and an overhead power cable from the school building. Three loud speakers were distributed around the ground.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

A MILLIAMMETER connected in series with the H.T. supply lead to a push-pull output stage does not give quite the same indications of distortion as in the case of a single output valve. For instance, there is no reason to be perturbed by slight movements of the meter needle during heavily modulated passages. One of the advantages of push-pull is that under certain conditions each valve may be operated in a slightly overloaded condition without any audible distortion; this is because the distortion introduced by individual valves is, up to a point, cancelled out.

Push-pull Distortion-meter

AN important change in broadcasting conditions is to be expected in a few months, when the new Droitwich long-wave station will take over the sole transmission of the National programme, at present being radiated by several medium-wave stations in addition to long-wave Daventry.

A Broadcasting Revolution

If the new station comes up to expectations, users of sets with a fair margin of sensitivity will not be greatly affected, no matter in what part of the country they may live. But owners of local-station "quality" sets in the more remote districts will be in a quandary; many of them will be unable to receive the National programme (which is presumably the favourite one) in as satisfactory a manner as at present.

Unfortunately, many users of the Power Radiogram, one of the most popular short-range high-quality sets described in *The Wireless World*, will be thus affected, and it is the purpose of this note to show a way out of the difficulty, and incidentally to suggest possible modifications to the receiver. Although it was designed over two years ago, the basic circuit arrangement may still be regarded as satisfactory for the purpose for which it was intended, and it is doubtful if drastic alterations are advisable.

With regard to the tuning arrangements, however, matters can certainly be improved by fitting good iron-cored coils and a modern two-gang condenser, preferably with a concentric trimmer. Although these alterations will make little, if any, real improvement to sensitivity, it is possible that operation will be made easier, and so the effective range of the set will be increased to such an extent that the new Droitwich station will be receivable over a wider area. In the interests of quality, however, the station should be regarded as being definitely out of range if it becomes necessary to make excessive use of reaction.

In such cases the only thing to do is to add an H.F. stage, which can be done fairly simply by adopting the arrangement described at some length in *The Wireless World* of March 24th, 1933.

Due to the exceptional high-note response of the Power Radiogram, especially when it is operated with close coupling between the component circuits of the input tuner, it is a fact that whistle interference from distant stations often becomes evident, particularly after dark. It is worth while pointing out that this form of interference may best be removed by fitting a well-designed whistle filter, which may be of the type described in *The Wireless World* for November 10th, 1933. Connections of the filter are given in Fig. 1, where additions and alterations are shown in full lines.

As the filter was designed to work in conjunction with input and output loads of 10,000 ohms, it is desirable to employ a detector valve of considerably lower impedance than was originally specified, and also to fit a coupling resistance (R6) of 10,000 or 15,000 ohms.

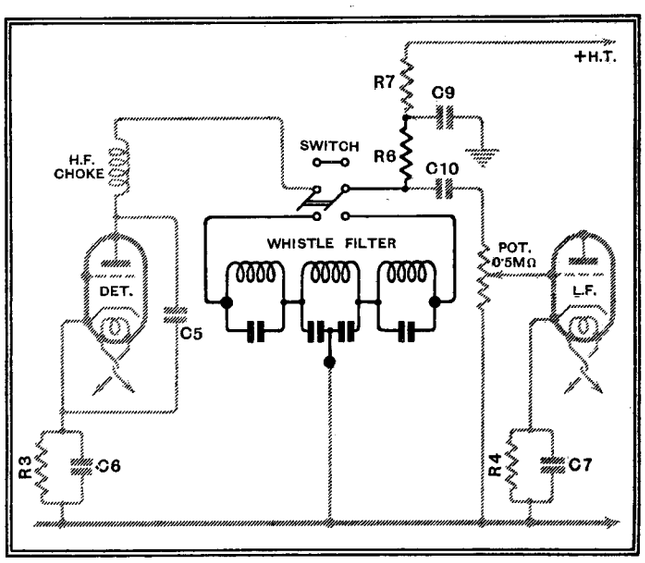
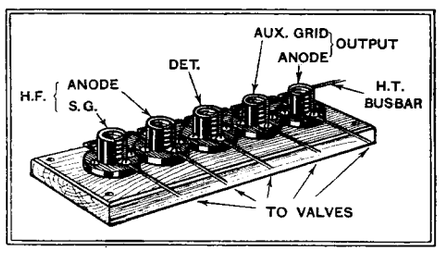


Fig. 1.—Heterodyne whistle suppressor with cut-out switch.

NO better check on the performance of a receiver can be made than by taking occasional measurements of the current passing in the anode circuits of each individual valve, and even in the screening grid and auxiliary grid circuits as well. If a record is kept of the various currents an almost infallible indication can be obtained of the condition of the set as a whole, and also of the most likely position of any defect, whether it be in a valve or in the associated circuits. Further, the knowledge that anode currents are everywhere normal gives one a feeling of security and confidence, showing as it does, in nine cases out of ten, that any observed falling off in performance is probably due to outside causes or to some accessory, such as the aerial-earth system or to the loud speaker.

Monitoring Points



Combined fuse-lamp holders and "break-in" connections for inserting a milliammeter in each H.T. feed circuit.

Although we may appreciate the importance of anode current measurements we are inclined to put off the task indefinitely, for the reason that in the modern compact set it is none too easy to find a convenient "break-in" point for connecting the milliammeter.

If convenient and accessible junction points were provided as a matter of course in each and every anode circuit there would be no excuse for anyone in possession of a meter to postpone the task of taking measurements. It is therefore urged that when building a new set this provision should be made. It takes very little time, involves little expense, and can be done in a number of different ways. One might, for example, arrange an ebonite terminal strip with grouped pairs of terminals, each with their short-circuiting strip, or else a ready-made terminal block with suitable U-shaped connectors could be substituted. As an alternative, the arrangement illustrated in the accompanying sketch, which was recently noticed in an amateur-built receiver, might be adopted. In this case a bakelite flash lamp holder was wired in series with the feed lead to each anode and screening grid, etc., the lamps serving as protective fuses and at the same time providing a convenient method of interrupting the circuits. To make a measurement of current in any particular circuit the lamp is partly or completely removed, and the meter leads are applied across the terminals of its holder. Although a lamp may not afford *complete* protection, its presence does at least reduce the risk of harm.

BROADCAST BREVITIES

By Our Special Correspondent

News from Maida Vale

WORK is beginning at once on the construction of the B.B.C.'s largest studio —that in the old skating rink at Maida Vale. The rink itself will form the main studio, which when completed will measure 110 feet long, 72 feet wide, and 35 feet high. This is considerably larger even than the famous Concert Hall in Broadcasting House, which measures 106 feet long, 42 feet wide, and 31 feet high.

A Six Months' Job

The work on the main studio will occupy the contractors some six months. At the end of that time it is probable that the restaurant and artistes' green rooms will also be fitted up.

It looks as if the B.B.C. National Symphony Orchestra may at last find a home of its own.

Research in a Garden

THE Research Engineers of the B.B.C. are much happier in their new headquarters at Nightingale Square, Balham. The move was finished on Sunday last, March 25th. Among the advantages of the new premises are better and larger rooms than those in Nightingale Lane, and—nearly as important—a big garden for the erection of aerials. Workers in the laboratory find much less vibration and noise caused by traffic.

I hear that the acoustic research branch has joined the Balham contingent, having moved from Avenue House, Clapham.

Not in Town To-night

I AM not surprised that Eric Maschwitz, the B.B.C.'s Variety Director, is feeling the strain of office and is about to go on a holiday. By the time these lines are read he hopes to be in some isolated spot where the postman calls only once daily and the inhabitants have not even heard of wireless.

This latter clause rules out even Tristan da Cunha and the Philippine Islands, but, in any case, "Eric" specifies a locality not more than a hundred miles from London.

Selling Programmes to the Empire

MR. MALCOLM FROST, the B.B.C.'s Empire "ambassador," has returned to Broadcasting House after a 50,000-mile tour, in the course of which he has successfully disposed of the twelve recorded B.B.C. programmes to various broadcasting organisations.

Not Oliver Twist

The only strange thing is that the Empire has not asked for more; apparently, there is no question of recording any more British programmes at the present time.

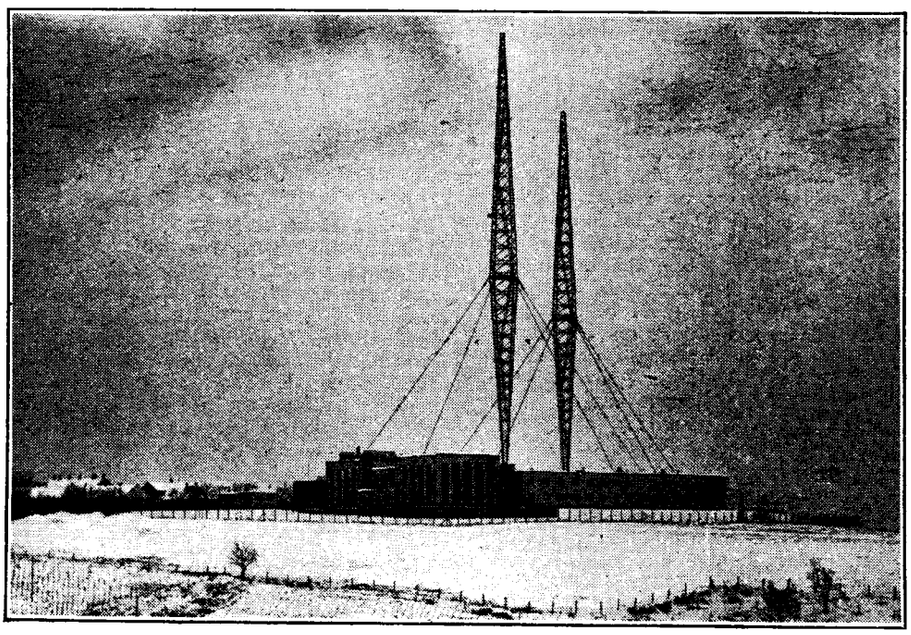
The Long-distance Test

The Empire Department at Broadcasting House are waiting in some trepidation for the return of the Chairman, Mr. J. H. Whitley, who has combined a health trip with a tour of duty. In South America, where he is recovering from a bout of illness, Mr. Whitley is tuning in, or attempting to tune in, the short-wave transmissions from Daventry.

The Empire Department in Portland Place are intensely sincere in the hope that the Chairman is hearing the programmes with ease, although rumour has it that the power of short-wave Daventry is being boosted on this account.

From European Capitals

WITH the cessation of Mr. Vernon Bartlett's regular series of talks, the B.B.C. will continue the feature, "The Week Abroad," but in place of Mr. Vernon Bartlett will relay talks from the different capitals of Europe. These talks will be arranged as far as possible to coincide with events of special interest or significance in the various countries and the speakers will be experts in foreign affairs. The series will be given on Thursday evenings from April to June.



WHY VIENNA SOUNDS LOUD. A new photograph showing the Bisamberg station with its twin vertical radiators. The second was erected to comply with listeners' demands for a more powerful service.

Prince George at the Microphone

PRINCE GEORGE will be entertained at a banquet at Grosvenor House, London, on May 2nd, on the occasion of his return from South Africa. The banquet is to be given by the Royal Empire Society, the British Empire League, the African Society, the Victoria League, the Overseas League, and the British Empire Club.

Prince George's speech will be relayed from Grosvenor House in the National programme.

Short Measure

A READER writes: "I have a grouse against the B.B.C. Whereas they used to give us the 'Londonderry Air' six times a day, now we get it only twice."

A Cosmopolitan Affair

S. P. B. MAIS will make a rather unusual microphone appearance for a talented author when he introduces "Cosmopolitan Cabaret"—a new type of programme for London Regional listeners—on April 11th. The turns will be varied, leading off with Bob Murphy, Dick and Dorothy (Our American Cousins), and Dora Stroeva, the Russian singer. Jean Sablon will be heard in his number from "Rococo," relayed from Paris, and another exotic touch will be added by Java and his Tziganes.

Mystery at the "Mike"

AN idea which was introduced into the Saturday night programmes some years ago is to be brought back in a new form next spring. The original idea was a mystery serial story, each instalment over several weeks being written by a different author, who broadcast his or her instalment in person.

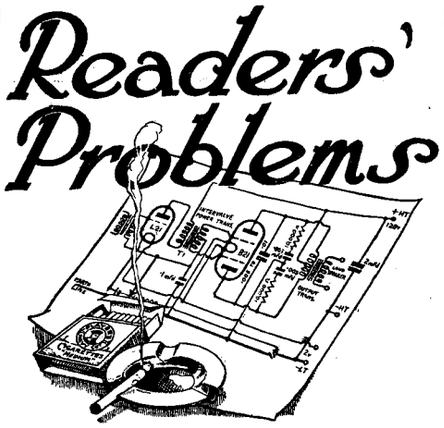
The new series will be given on Fridays, and each story will be complete in itself. Well-known authors are contributors. Agatha Christie opens the series on April 6th. Dorothy L. Sayers, Compton Mackenzie, and Walter de la Mare are future contributors.

Here is a series which might well go on for ever. To my mind, there is a real opening for the microphone thriller—the sort of tale which sounds best when heard from the author's own lips.

Morning Television

WHO wants morning television? The question does not bother the B.B.C., for from next week onwards, until further notice, the 30-line tests will be given at 11 p.m. on Tuesdays and 11 a.m. on Fridays.

Readers' Problems



THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page

Roundabout Measurements

WE all know that the anode voltage of a valve cannot be measured exactly by ordinary means. An electrostatic meter, or a valve voltmeter, is necessary for this purpose.

A correspondent, who appreciates this point, seems nevertheless to suffer from an inordinate desire for precise information on the subject, and asks for suggestions as to how ordinary measuring apparatus may be used to ascertain the working anode voltage of a valve: the example he gives is a detector in the anode circuit of which a relatively high value of resistance, comprising a transformer primary and a decoupling resistance, is included.

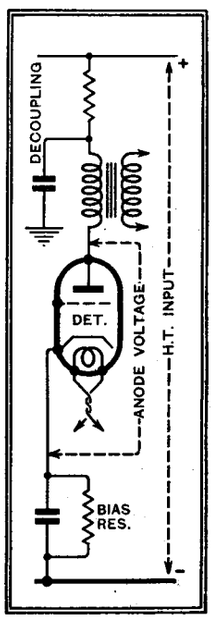


Fig. 1.—Explains the measurement and calculation of anode voltage.

This is a case for indirect methods. The procedure is to measure the voltage of the H.T. input to the valve, and then to measure the total ohmic value of the various resistances included in its anode circuit, not forgetting that a cathode bias resistor, if one should be fitted for purposes of gramophone reproduction, is a part of the anode circuit. (See Fig. 1.)

Anode current is then measured, and the total voltage drop external to the valve is then calculated ($I \times R$), and subtracted from the H.T. input voltage. What remains is the voltage actually existing between anode and cathode of the valve, under the working conditions prevailing when the measurements were made.

Even after going to all this trouble there still remains the possibility of error. We have tacitly assumed that the voltage of the H.T. input can be accurately measured, but if it comes from the usual source—an H.T. rectifying and smoothing system—there may be a slight inaccuracy in making the measurement. After all, a precise knowledge of working anode voltage is not particularly valuable in most cases, and the tendency is to rely more and more upon readings of anode current.

The Isolating Valve

AN aperiodic H.F. stage, of the type commonly used in short-wave receivers, confers little, if any, true H.F. amplification; indeed, in certain circumstances, amplification may be a minus quantity. But, paradoxical as it may appear, the addition of such a stage to a short-wave set is to be recommended.

This is in reply to a querist who asks whether it would be worth while adding a screen grid high-frequency valve to his "autodyne" short-wave superheterodyne, which appears to be somewhat lacking in sensitivity. This addition is to be advocated, not so much because it will contribute much true H.F. amplification, but because it will isolate the tuned circuit from the aerial, and, by removing a source of damping, will make operation very much simpler and more certain. Further, it will reduce the risk of interfering with other short-wave listeners.

External Volume Control

ALTHOUGH there may be more convenient methods of controlling volume from a point remote from the receiver, there can be little doubt that the safest plan is to make provision for varying the grid bias of variable-mu H.F. or I.F. valves. This is done in the usual way with the help of a potentiometer, which, instead of being mounted in the set, is installed at the remote point and wired by means of a triple cable.

Other methods, and particularly those that are applied directly to the loud speaker, are liable to introduce more or less serious frequency distortion, particularly at low volume settings. An arrangement of this nature, submitted by a reader for criticism, includes provision for compensation, and might be made to work satisfactorily, but is so complicated and expensive that it would appear to have no advantages over H.F. bias control.

Selectivity of the Superhet

THE majority of modern superheterodynes seldom have more than two tuned signal-frequency circuits, and so it should be borne in mind that adjacent-channel selectivity is mainly controlled by the I.F. circuits.

A querist, writing on the subject of unexpected interference from adjacent-channel stations, seems to have concentrated most of his efforts to improve matters upon the signal-frequency circuits. From his description of the unsatisfactory behaviour of the set, there can be little doubt that this section of the receiver is free from blame, and that the lack of selectivity must be due to a defect—or more probably to incorrect adjustment—in the I.F. amplifier.

Payment by Results

IT would appear that many readers have been intrigued by the extremely ingenious circuit arrangement embodied in the Bush Battery Superheterodyne, which was reviewed in *The Wireless World* of February 16th. It may be remembered that in this receiver a Westector acts as a second detector, and in addition to providing "quiet" amplified A.V.C. in conjunction with the output valve, it also acts as a battery economy device. It is with the latter function that we are primarily concerned at the moment.

Queries on the subject would indicate that the principle of this battery economy system is not always properly understood. Unlike the better-known "quiescent" systems, the current demands of the output stage are not affected by modulation, but by the amplitude of the carrier wave. The arrangement is really a very simple one, and its operation can best be understood by referring to the diagram given in Fig. 2.

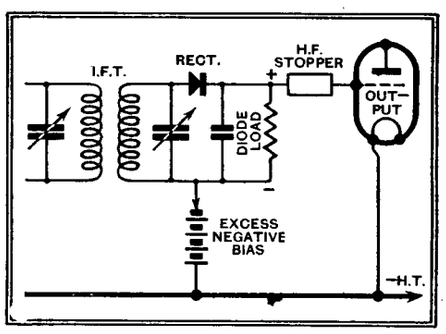


Fig. 2.—Simplified diagram showing the operation of a novel battery-economy system, in which the output valve bias is automatically reduced to cope with signals of varying strength.

When no signal is being received, the output valve is heavily over-biased, with the result that its H.T. current consumption is extremely low. As soon as a signal is applied to the Westector, however, a rectified voltage of opposite polarity is built up across the load resistance and tends to reduce the negative bias of the valve grid. This rectified voltage is proportional to the strength of the carrier, and so the valve is automatically biased to the right point for accepting incoming signals of varying strengths without wastage of anode current.

It will be appreciated that the rectifier must be connected in such a way that its output tends to make the grid more positive (or, rather, less negative) than under no-signal conditions. A querist asks whether a diode valve could be used in place of the Westector; this is impracticable, for the reason that a battery-fed diode cannot conveniently be connected in such a way as to give a "positive" rectified output.

The Wireless World INFORMATION BUREAU

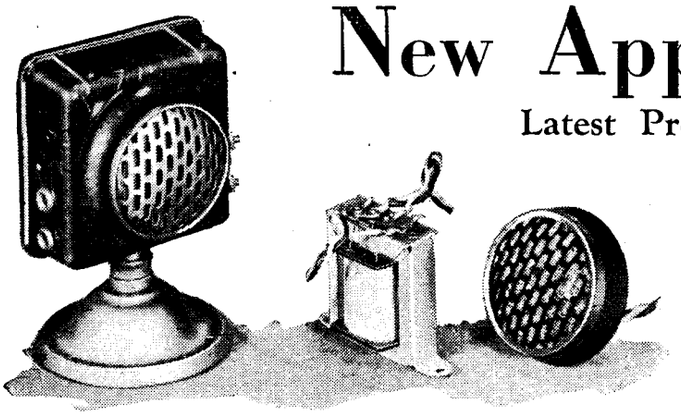
THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

New Apparatus Reviewed

Latest Products of the Manufacturers



Electradix microphones, model W.W.11 on stand and the No. 11 unit with its transformer.

ELECTRADIX MICROPHONES

A HIGH-GRADE microphone is an expensive instrument, the cost of which is hardly justified if it is to be used only for amusement purposes. Yet a microphone is a useful adjunct to a broadcast set, as it will afford considerable entertainment where friends have foregathered for an evening's amusement, for, joined to the gramophone pick-up terminals, home broadcasts can be staged with good effect.

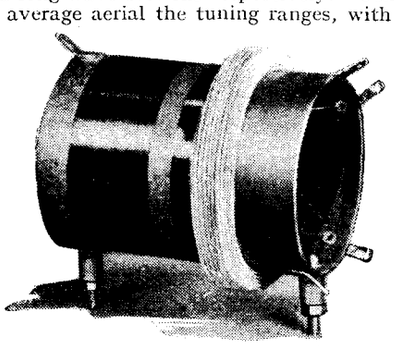
Inexpensive microphones quite suitable for this purpose are obtainable from Electradix Radios, 218, Upper Thames Street, London, E.C.4, a table model, listed as the type W.W.11, costing 10s. 6d., including a built-in transformer. The specimen tested transmitted speech with reasonably good fidelity, voices being easily recognisable, but for best results it is necessary to speak close to the microphone.

Several other models are available, either mounted on stands or in the form of the carbon unit only, such as the type No. 11, the price of which is 5s. 6d. A transformer suitable for the latter unit costs 4s. 6d.

MAGNUM DUAL-RANGE COIL

BURNE-JONES & CO., LTD., Magnum House, 296, Borough High Street, London, S.E.1, have introduced an inexpensive dual-range aerial coil suitable for use in the simpler type of sets. It is wound on a 2in. former and is 3in. long. It includes a reaction winding located in the space between the medium- and the long-wave sections of the grid coil.

The measured inductance was found to be 180 mH. and 1,890 mH. for the medium- and long-wave sections respectively. Using an average aerial the tuning ranges, with a



An inexpensive dual-range aerial coil made by Burne-Jones and Co., Ltd.

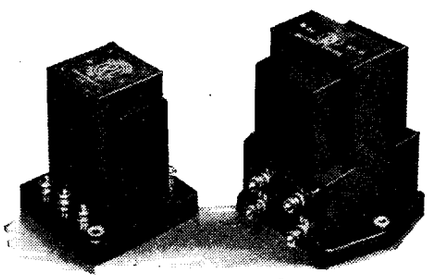
0.0005 mfd. condenser, are 190 metres to 580 metres and 1,060 to 2,100 metres. A series aerial condenser of 0.0001 mfd. was employed, as while a tapping is provided on the medium-wave section no such provision is made for the long waves, and this fitment is desirable in the interests of selectivity.

Reaction was considerably improved by inserting a 2,000-ohm resistor in series with the reaction coil, as we found that spurious oscillations were present on the long-wave band, the circuit oscillating with the initial movement of the reaction condenser at some frequency different to that to which the circuit was tuned. The customary shunt-feed reaction arrangement using an H.F. choke was employed.

It is a very efficient coil and compares favourably with many costing considerably more, for its price is only 2s. 6d.

R.I. Q.P.P. COMPONENTS

A REVIVAL of interest in the Q.P.P. output system is foreshadowed by the introduction of a new double-pentode out-



R. I. Q.P.P. intervalve transformer Model DY34 and output matching choke, Type DY53.

put valve and the special intervalve transformers and loud speaker matching chokes will be in demand. Radio Instruments, Ltd., Purley Way, Croydon, have included components of this type in their range for some time, but now a new Q.P.P. double-pentode choke for matching existing loud speakers to the new valves has been added.

Known as the Model DY53, the specimen sent in for test was found to have an inductance of about 75 henrys total, each half, with no D.C. flowing, being of the order of 20 henrys. An out-of-balance current of 10 mA. reduced the inductance of that half of the winding to 10 henrys. The total resistance is 380 ohms.

Tappings are provided for matching purposes, and these give the choice of three ratios, viz., 1.2 to 1, 1.7 to 1 and 2 to 1.

Tests were made also with the R.I. Q.P.P. intervalve transformer, model DY34. It has a ratio of 1 to 8 overall, and the secondary is centre tapped. Its measured primary inductance, with no D.C. flowing, was 25 henrys.

Finally, these two components were included in a Q.P.P. two-stage amplifier. The reproduction was exceedingly good; judged orally the balance between bass and treble was well proportioned, and this amplifier was adequate to fill a medium-size room on either gramophone or radio. The choke offered ample latitude for matching the loud speaker to the output valves.

Both components are housed in an attractive moulded bakelite case with the terminals accessible, and the price is 12s. 6d. for the choke and 16s. 6d. for the transformer.

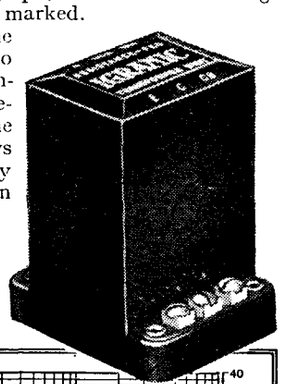
IGRANIC COUPLING UNIT

THIS unit consists of a miniature L.F. transformer, a tapped wire-wound resistance and a coupling condenser assembled in a neat moulded bakelite case measuring $2\frac{1}{8}$in. × $1\frac{7}{8}$in. × $2\frac{11}{16}$in. high. It forms a parallel-feed transformer coupling unit with a transformer step-up ratio of 1 to 4.5, having a primary inductance of the order of 95 henrys.

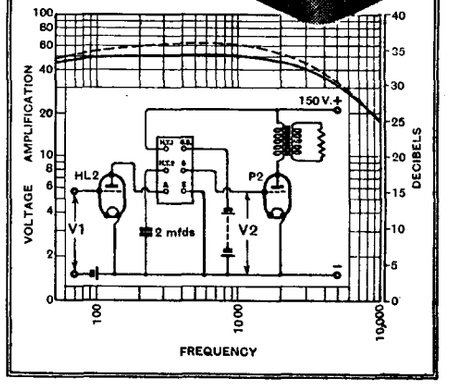
The resistance is divided by a tapping into two parts, one of 30,000 ohms and the other of 20,000 ohms, and either the whole or the 30,000-ohm section can be employed as the feed resistance; in the latter case, the idle 20,000 ohms could be utilised as a decoupling resistance.

Using a valve preceding the unit of some 18,000 ohms A.C. resistance, slightly more amplification is obtained with the whole 50,000 ohms as the feed resistance and an external decoupling resistance. Where, however, the H.T. voltage available is insufficient to allow this arrangement being used, a total of 50,000 ohms only in the anode circuit, proportioned as mentioned above, will give quite satisfactory results. For, as can be seen by the amplification curves on the graph, the increased voltage gain is not very marked.

The full line curve relates to the last-mentioned arrangement, while the dotted line shows the slightly better stage gain



Igranic resistance-fed transformer coupling unit.



resulting from the full 50,000 ohms as the feed resistance.

The makers are the Igranic Electric Co., Ltd., 147, Queen Victoria Street, London, E.C.4, and the price is 10s. 6d.

UNBIASED

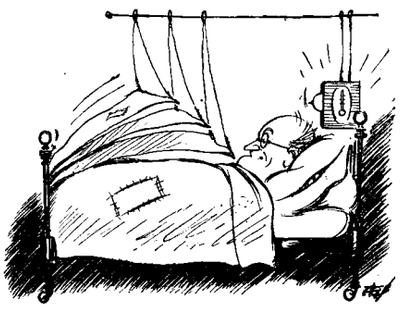
By FREE GRID

Why I Was Shocked

I HAVE always been in favour of letting the public have the benefit of a new invention as soon as it is old enough to leave its mother. As a result of being nearly roasted alive a few nights ago as well as receiving a violent electric shock, I am inclined to think, however, that there is something to be said for allowing the weaning process to be prolonged.

As we all know, the temperature in this country is subject to such sudden and violent fluctuations that one may go to bed at midnight with only a couple of blankets on and wake up shivering half an hour later owing to a sudden cold wave.

Many years ago I settled this problem by rigging up over my bed an arrangement of pulleys which automatically removed or placed blankets on me during the night according to the fluctuations of tempera-



Perfectly straightforward device.

ture. This was done through a thermostatically-controlled electric motor. The thermostat itself was a perfectly straightforward device of my own construction. It consisted of an ordinary thermometer with a wire fused into the bulb and twelve others fused into the glass at various predetermined temperature readings. As the six contacts were closed or opened by the varying height of the mercury column, the corresponding six blankets were raised or lowered.

Recently, my pulleys, electric motor and bed coverings were replaced by six thin electric blankets, any number of which from one to six are switched into circuit by a modern thermostat.

All went well on the first night; on the second, however, it was exceedingly mild and when I retired I noticed that all blankets, save one, were switched off. It would appear that as the night advanced the temperature rose still further, but owing to something going wrong with the innards of the thermostat it went beserk and commenced switching blankets on instead of off.

This caused me to perspire very profusely in my sleep and I was suddenly awakened by an agonising electric shock. The perspiration had soaked through the blankets and so made the necessary contact between my body and the mains.

So Simple

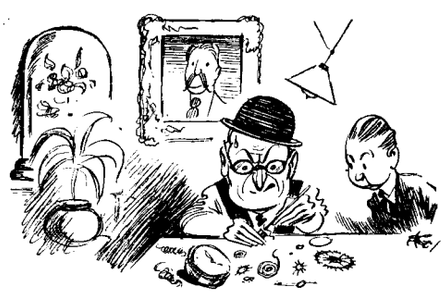
A YOUNG friend of mine, a keen radio enthusiast, came to me the other day in deep woe after a dispute with his landlady.

The good dame, apparently, had forbidden him to connect a set to the mains because "it might blow up and cause us all to perish in our beds." Even the offer that she be allowed to charge for it as one of the "extras" so beloved of landladies failed to disperse her fears, and eventually my young friend had to content himself with Class "B."

Recently, however, he had again approached the darner of his pants for permission to plug-in an all-mains clock. Again she was adamant in her refusal. Since split-second punctuality is a fetish of his, he was exceedingly distressed.

I am very pleased to be able to report that by the execution of a little ingenuity I have succeeded in banishing his sorrows, and since there may be other readers in similar straits I herewith disclose my little scheme to all and sundry without fee or obligation.

The problem I faced was indeed a stupendous one, for I undertook to produce a clock the mechanism of which would be controlled by the mains without any tangible connection; in other words, it must be a wireless clock. It would be idle to pursue the train of thought that eventually evoked recollections of the eyestrain and nervous shock which I had suffered some time ago (vide *The Wireless World*, February 16, 1934) as a result of the winking and blinking of lights on an



The work of an evening.

A.C. supply of low periodicity. I suddenly realised that although my eyes could detect no flicker in standard 50 cycle mains it would be readily revealed to a photo-electric cell. It was but the work of an evening to apply this principle to my problem and rig up a clock whose escapement was monitored every hundredth part of a second by the successive half-cycles of current.

My young friend is now in possession of a time-piece which is fully as accurate as any synchronous motor arrangement, while his landlady continues to sleep peacefully in her bed at night, thus furnishing a truly excellent example of the old proverb which deals with the bliss of ignorance.

A Big Drop

I HAVE always had a soft spot in my heart for the small wireless retailer, for I have always thought that, if ever he has been guilty of deceiving the unwary into buying dubious goods he has been encouraged in this by the negligent attitude of certain manufacturers in allowing the local plumber to compete with him.

Assuming the cloak of humility.

It was with joy, therefore, that I was recently able completely to vindicate a local dealer, whom a friend of mine had accused of guilt, by bringing the crime home to a prominent valve maker.

The whole affair arose out of the fact that my friend suspected that his local retailer was attempting to palm off semi-dud valves as new. To confirm his suspicions, he had bought a couple of ostensibly new valves from his dealer and had then gone straightway to the showrooms of the valve-makers and asked them to test them, with the result that the valves were said to be "down" in emission by some fifty per cent.

Hearing what had happened I prevailed upon my friend to spend good money on another couple of valves in the interests of justice and fair play, and, having explained my plot to him, went with him to the valve maker's sumptuous showrooms. Bidding my friend be seated I purchased a couple of valves on his behalf. Then retiring to the street for a few moments, I pulled a cloth cap and muffler from my pocket and made a few necessary changes in my toilet.

Assuming the cloak of humility, I re-entered the showrooms with a politely worded request that my valves be tested. A bespatted young man took them from me with the air of one receiving something unwholesome from a tramp. After an interval of a few minutes another individual handed them back to me with the statement that one was sixty and the other no less than seventy per cent. "down" on emission.

It is, perhaps, better for the dignity of all concerned that a veil be drawn over subsequent proceedings, more especially as the matter is at present *pendente lite*.